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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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Refractories.

Though strange, it is nevertheless true that the greatest differences exist in the life of cupola linings. Even when on similar work we have met with cases where a lining in one foundry has lasted more years than weeks in a second. We are convinced from actual practical experience of refractory bricks in general that there are two factors which are neglected alike by the scientific investigator and the majority of practical men. The first of these factors is that the imposition of pressure on most types of bricks lowers their fusing point and certainly makes them more chemically active to materials on the other side of the resultant compound. The second factor is the relative heat conductivity. To put the case in words readily understood by non-technical foundrymen, if the exposed surface of a brick has to deal with all the heat submitted to it, and is not in a position to pass some of it back, then it may mean just that difference between fusing or "sticking up to its work." Apparently this property depends upon the closeness of texture, for if the grains are in intimate contact they can more easily pass back the heat received. To return to the first factor, and to consider how it is to be tackled. The two main contributory causes which can place a brick under compression are the weight of superimposed brickwork and expansion. The former can be overcome by suitable steelwork supports and the second by adequate expansion joints. Both these are rendered more difficult of accomplishment by badly-shaped bricks or shapes. The second factor, that of heat-conducting properties, is difficult to control, but a poor-quality brick which has failed in practice often reveals an unused or a new appearance on the face which has not been exposed to heat, whereas a thoroughly efficient brick usually exhibits a burnt or baked appearance. This leads one to believe that the poor brick was unable to disperse the heat received. Bricks should, of course, be analysed, and if this is satisfactory then they should be examined for closeness of fracture, which we believe has some relationship to the heat conductivity. Finally, all brickwork should be insulated from the ironwork by imprisoned air. Whether sand, Kieselguhr or brickbats is used for this purpose is governed by considerations of shock, vibration and other movements likely to disturb the medium used.

From this reasoning it should be clear that the brickwork exposed to the heat should have a light covering of a plastic refractory containing many air spaces and loose texture, because such a material cannot be under pressure and will only fuse at its melting point, uninfluenced by pressure considerations. Further, its porous nature prevents it from passing the heat received back to the actual bricks.

Summarised, the foundryman should specify shape, dimensional limits, ascertain as much information, even though it be empirical of the expansion and heat conductivity, and construct his furnace accordingly, so that at full heat the pressure on the brickwork is at a minimum. The back should be insulated from the ironwork by an air-imprisoning medium and at the front from the full heat by a refractory paint.

The Making of Semi-Steel Castings.

G. W. GILDERMAN.*

Semi-steel is a term that has been much abused. The mixtures parading under this title and the manner in which these mixtures have been made has been so varied that until a few years ago semi-steel was considered more or less of a joke. In fact, there are men to-day who are under the opinion that semi-steel is just a close-grained iron.

Foundrymen are, however, making a semi-steel to-day that is well worthy of its name, and were it not for this metal, the automobile industry would not find itself enjoying the prosperity it is to-day, as semi-steel is used almost entirely in the production of motor parts, for not only automobiles but all internal combustion engines. For the reason that these castings require a close-grained, strong metal, something that will stand wear and tear that the castings are subject to. Where the ordinary grey iron usually breaks at from 2,300 to 2,700 lbs. it is not common for semi-steel to break at 3,600 lbs., and the author has had bars that broke as high as 4,000 lbs., but this is not to be expected in every-day practice.

In the early days of the gas-engine, in order to close the grain of the cylinders it was customary to break up old files and throw them in to the ladle, and then with a skimmer the moulder would stir and puddle the mass until he felt he had it properly amalgamated. Sometimes he would get a good cylinder and sometimes not. More often not. If the cylinder was good, he gave the files credit for it; if not, the problem remained unsolved.

No one seems to know just when semi-steel ceased to be an experiment. In fact, the author does not remember when he made his first semi-steel heat, for the reason that when he began making it in the cupola he used a very small percentage of steel, gradually increasing until 40 per cent. was reached. This has since been reduced to 20 to 25 per cent., and he finds this gives about the same results, with less trouble in handling the metal.

Mixtures and Charging.

In determining the mixtures, a casting with a section ¾ in. thick, will be given as an example. The analysis of this should be:— Silicon, 1.60; manganese, 0.75; phosphorus, 0.40; and sulphur, about 0.09 per cent. To arrive at this, 60 per cent. pig-iron, 20 per cent. steel scrap, and 20 per cent. cast scrap is used. The pig-iron contains:— Silicon, 2.30; manganese, 1.25; phosphorus, about 0.40; and sulphur, less than 0.05 per cent. If the foundry is unable to get iron running as high as 1.25 per cent. manganese it makes up the difference by adding 80 per cent. ferro-manganese in the cupola.

In making up the charges, the first thing to be considered is the size of the steel; if it is heavy, and by heavy is meant the ends of T-rails and I-beams or a corresponding section, it should be placed on top of the charge, in order that it should be charged directly on top of the coke, keeping about 8 ins. from the cupola wall, reserving this space for pig-iron. If the steel scrap is small and scrap down to ¼ in. thickness has been used, the process should be reversed, placing the pig-iron on top of the coke and scattering scrap over the charge.

Semi-steel should be melted hot. It would be unfair to say what the ratio should be, as that depends upon local conditions. The general practice, however, is about the same as grey iron. In his practice, the author has at times found it necessary to use about 5 per cent. additional coke when the scrap was extra heavy. Small charges, about 1,000 lbs. in the 48-in. cupola and 2,000 lbs. in a 60-in. cupola, are used.

Preparation of Mould.

Semi-steel should be handled a trifle faster than grey iron, as it sets more rapidly. This should be taken into consideration in gating the mould and in determining the size of the riser. It has been the author's practice where a riser is put on a semi-steel mould to make it about 50 per cent. larger than for grey iron.

Semi-steel has more shrinkage than grey iron, but in using from 20 to 25 per cent. steel it has never been found necessary to use more than ⅛ in. shrinkage to the foot in the construction of the patterns.

In the preparation of the mould, about the same practice as with grey iron has been used, with these exceptions:—More new sand is used in the facing sometimes as much as 50 per cent. new sand—depending on the nature of the sand—but never less than 33 per cent. This refers to light castings made in green sand. If the castings weigh from 500 lbs. or more to one ton, the author generally uses a skin-dried mould, the facing being made with a pitch compound, consisting of about 20 parts of sand to one of the compound. For castings weighing over one ton a dry sand facing, liberally studded with large-headed nails, is used. The facing sand is as follows:— To 1 cub. yard of heavy new sand there are added about 12 cub. ft. of sharp sand, 140 lbs. of flour and 2 quarts of molasses. All dried moulds are treated to a coat of black-wash before being dried. The compound facing can be dried with a torch; the dry sand facing should be dried with charcoal. The author's foundry also uses a deep cope or builds up the runner box and risers in order to get a heavy head pressure. When it is possible a churning rod is used in the risers; if not, the riser is covered with sea-coal as soon as the mould is poured. This, of course, is to keep the riser fluid as long as possible.

Pattern Proportion.

Probably the most dangerous pitfall in the manufacture of semi-steel castings is pattern or casting proportion, the publication of articles on 40 and even 50 per cent. semi-steel have given impressions that the higher percentage of steel would act as a "cure-all." The percentage of steel, however, makes no difference unless the proportion of the casting is carefully considered. Before attempting to make a new casting, we look the drawing over very carefully in order to locate any heavy spots. If there is a heavy section connected to lighter sections, and there is no visible means of feeding this particular spot, this pattern is considered out of proportion. The job is then to find some way to feed this section of the casting or to compel it to solidify as soon as the sections surrounding it.

The latter method is usually adopted, and is accomplished by the use of chills, either rammed up in the mould or in the core. This is rather complicated, and it is proposed to use a simple example, a blank gear about 24 ins. dia., with 3-in. face, a rim thickness of 2 ins., and an arm about 1 to 1¼ ins. thick as explanatory.

At the intersection of the arm and rim, there is the heaviest metal and consequently the last place to solidify. This, of course, causes this section of the casting to feed that portion of the rim between the arms, with the result that when the teeth are cut in the rim it is found that a spongy spot appears at the base of the teeth, directly opposite the place where the arm joins the rim.

To overcome this, a chill is placed under each arm at the intersection of the rim. The chill is not only rammed against the arm but the rim as well. The chill represents a case of a shape that will conform to this particular part of the pattern. Chills for the size wheels mentioned should be approximately 1½ ins. sq.

It is generally found that the same conditions occur in cylinders, cylinder heads and pistons.

Alloys.

As semi-steel is generally used in castings, where sound, clean metal is one of the main requirements, it is necessary to use some sort of flux or scavenger in the ladle. For this the author has used aluminium, ferro-titanium and ferro-vanadium.

The aluminium used contains about 92 per cent. aluminium, 1 per cent. silicon, and nearly 7 per cent. copper. It is used, however, for the aluminium content alone. When aluminium is added to molten semi-steel it melts very rapidly and rises to the top of the metal, owing to its low specific gravity. Little or no aluminium will be found in the metal, as the aluminium is dissipated by oxidation and rises to the top with the slag, carrying

* Mr. Gilderman is Foundry Manager to the Dodge Manufacturing Corporation, of Meshawaka, Indiana, U.S.A.

with it most of the gases contained in the molten metal, hence it acts as a purifier and results in the castings being cleaner and more sound. About ¼ oz. to each 100 lbs. of metal is used.

The usual ferro-titanium on the market contains from 10 to 50 per cent. titanium, and like aluminium acts as the purifier by removing gases, but its action is more intense. Where a small quantity is used, none of it alloys with the metal, but where a large quantity is used, some of it alloys with the metal. In either case the metal is improved and strengthened. About 1 oz. of 15 per cent. ferro-titanium to each 100 lbs. of metal is used. Ferro-vanadium usually contains from 10 to 50 per cent. vanadium. It acts in a small way as a purifier. The real benefit received, however, is in the increased strength. The action apparently is to break up the large flakes of graphitic carbon, closing the grain and increasing the strength. It also enables the metal better to withstand repeated shocks. Vanadium is used more in piston rings than in any other castings. About 2 ozs. of 30 per cent. ferro-vanadium is added to each 100 lbs. of iron.

The object of this Paper is to give a general idea of the methods used in actual practice. These are not hard and fast rules, but something that can be used as a foundation to work from.

A Conveyor Exhibit.

Few exhibits at the International Foundry Trades' Exhibition at Birmingham attracted more attention than that of Messrs. W. & C. Pantin, of 147, Upper Thames Street, London, E.C.4, who showed under working conditions a combined gravity roller conveyor and woven wire belt conveyor.

The belt conveyor shown in the photograph is fitted with a "Crusader" double woven galvanised wire belt, 18 in. wide, made out of 12-gauge wire with a mesh of 1½ in. in each layer, giving an actual mesh of ¾ in.

This type of belt is cheaper than a rubber, cotton, or canvas belt, and it is particularly suitable for conveying hot materials or any articles likely to damage a fabric belt.

This belt, for conveying purposes, can be made in any gauge from 14 to 9 G, and in any mesh from ⅜ in. to 3 in., and in any width up to 6 ft.

The gravity roller conveyor is suitable for conveying any article with at least one hard, smooth surface capable of travelling over the rollers, the gradient required to convey these articles by gravity varying from 3 to 6 per cent.

The firm make a special type where the rollers are placed very close together, suitable for conveying sacks, and for this type 10 per cent. gradient is required. The rollers in the conveyor can be made in any length up to 24 in., and there are three standard sizes, viz., 1½ in., 2¼ in., and 3½ in. diameter.

The 1½ in. and 2¼ in. diameter are made out of 18-gauge seamless steel tubes, and the 3½ in. diameter are made out of 7-gauge lap-welded tubes. A special type of heavy conveyor, fitted with 4 in. to 6½ in. diameter rollers, has also been designed.

The rollers in the conveyor are fitted with a ball bearing at each end, and mounted on a through spindle, which is a fixture in the frame, the roller revolving on the spindle.

The 1½ in. dia. roller is fitted with a ⅜ in. dia. spindle, and the 2¼ in. dia. roller can be fitted with either a ⅜ in. or 7-16 in. dia. spindle. The 3½ in. dia. roller is fitted with a ⅝ in. dia. spindle, and the 4 in. and 6½ in. dia. rollers are fitted with a 1 in. dia. spindle.

For supporting these conveyors, adjustable trestles are furnished, one of which should be placed alongside each joint in the conveyor, generally about 8 ft. apart.

A CONVEYOR EXHIBIT AT THE BIRMINGHAM FOUNDRY TRADES EXHIBITION.

A PANEL PAINTING of the late Mr. Pascoe Grenfell has been unveiled at the Royal Exchange, London, E.C. Mr. Pascoe Grenfell was the founder of Pascoe, Grenfell & Sons, metal manufacturers, subsequently amalgamated with Williams, Foster & Company, the business now being carried on under the style of Williams, Foster & Company and Pascoe, Grenfell & Sons, Limited. Mr. Grenfell lived from 1761 to 1838.

AT THE ANNUAL Degree Day of the University of Birmingham recently, the honorary degree of Doctor of Laws was conferred by the Chancellor (Viscount Cecil of Chelwood) upon Sir Henry Fowler, K.B.E. In presenting him for the distinction the Principal of the University (Mr. Grant Robertson) observed that in the Birmingham University the recognition of science would be very incomplete without a representative of engineering. Sir Henry was the chief mechanical engineer of the Midland Railway, and they were proud to note a former student of Mason College. The Institution of Civil Engineers had shown their appreciation of his work by awarding him the highest distinctions that civil engineering could bestow: the Telford Premium and Medal and the Watt Medal and Webb Prize.

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Judging and Mixing Pig-irons.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—I read with interest the discussions you publish of the Papers read at the Newcastle Conference. In Mr. Young's contribution on Mr. Northcott's Paper he queries the cahbon figures published by the author.

It seems to me that this reverts, in some measure, to a previous statement in the FOUNDRY TRADE JOURNAL of September 27, 1923, which reads as follows:—"That few reliable analyses of cast iron or pig-iron are issued from the average laboratory."

Most workers are aware that a really representative sample is obtained with difficulty.

It occurs to me that Mr. Young might, through the medium of your paper, help to make such a state of affairs in general a thing of the past, by publishing the methods of sampling and analysis he so successfully employs, and which will "stand the scrutiny of the best referees." He says "it is a difficulty easily surmounted."

The Americans have standardised the methods of sampling and analysis.

To go a little further in my suggestions, why should not the Institute of British Foundrymen issue its own standard methods? It has among its members those who are fully qualified to draw up such standards.

These thoughts I venture to place before you, as I feel that the sooner we have rather more rigid methods of sampling, followed by accurate and reliable analysis, the better shall we be able to compare results and to draw conclusions with more certainty from the results published by all the workers in the field of cast-iron research, and in—what is of equal importance—daily practice.—Yours, etc.,

C. F. B.

July 10, 1924.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—My attention has been drawn to a Paper by Mr. H. J. Young, upon the methods of judging and mixing pig-irons, a condensed report of which appeared in THE FOUNDRY TRADE JOURNAL.

The author begins by drawing an analogy between non-ferrous and ferrous metallurgy, and expresses, what one has suspected for a long time, his conviction that ferrous metallurgy in general, and that of cast-iron in particular, can be understood from the view-point of the worker in non-ferrous metals.

You, sir, will no doubt agree that one's conception, and therefore one's knowledge of any subject or object, is largely determined by one's view-point, or angle of vision, and two or more observers or writers may view the same subject or object from different angles, and get impressions differing very widely.

Since his advent into cast-iron metallurgy, Mr. Young has been a prolific writer, and no doubt has carried out a large amount of research work upon cast-iron, but, alas, up to the present he appears disappointed that cast iron does not yield to his magic touch so readily as non-ferrous metals, and will not conform to any formula which he can establish, in fact one searches in vain for anything consistent and constructive in his writings.

In the Paper under review, Mr. Young has frankly told us, what some have realised for many years, that his conception of cast iron has been and still is based upon his early training in, and subsequent knowledge of, non-ferrous metals and their behaviour.

Having had over thirty years' chemical and metallurgical association with blast furnaces, steel furnaces and foundries, both iron and non-ferrous, one's conclusions regarding cast iron are far from coinciding with those of Mr. Young. Certainly one must judge aright, before one can mix cast iron aright. One's experience of cast iron and other metals has long since convinced one that to approach the understanding of cast iron, one must not be biased or influenced by one's knowledge of non-ferrous metals.

Again, the greater number of writers upon cast-iron have only foundry experience, and judge it by its behaviour in the cupola, and some of these are frank enough to confess they are amazed at the complexity of the subject.

Those, however, who in addition to foundry experience, have watched its behaviour in the steel furnace, and above all have studied it at the blast furnace, hesitate to pronounce dogmatically concerning it, knowing something of the complexity of the subject.

At the blast furnace, for example, there are so many pre-natal influences at work affecting the product, which are at present beyond the skill of the most expert and experienced worker to avoid: one authority upon the blast furnace states that under the best regulated conditions at the furnace, there are at least one million possible variants, any of which may defy control.

Is there any wonder that the purely foundry metallurgist finds his raw product so contradictory and so unsatisfactory? One is pleased to observe that Mr. Young has left the "Silicon school," and has joined the "Carbon school." He must not, however, think he has arrived, he is but arriving, and still has a long way to go.

He writes of combined carbon and graphitic carbon as if these were but two simple factors. He, however, will be the first to concede that the same quantity by weight of either can produce very conflicting and contradictory results, more pronounced than such results of combined carbon in steel.

Carbon is the basis of organic chemistry, and has produced a field of operations and research rivalling in extent that of all the other "elements" put together.

If, then, carbon has such a wide scope in its relation to, say, hydrogen, oxygen, nitrogen, who shall limit it, in its relation to iron and manganese.

Yours, etc.,

GEO. W. HEWSON.

71, Windsor Road, Forest Gate, London, E.7.
July 12, 1924.

Foundry Query.

Carborundum Chippings in Castings.

The writer, when in London last week, was shown some iron castings, one in the form of a cylinder and the other a small door, and on the inside of both of these castings the surface was roughened by chippings of carborundum. The writer was told that these chippings were in some way cast in the castings in order to give the desired roughness of surface. We shall be very much obliged if any reader can inform us whether this is possible, and, if not, what is the process necessary to achieve the desired result.—A. H. R.

Catalogues Received.

Induced Draught.—In a twelve page booklet, Messrs. James Keith and Blackman and Company, Limited, of 27, Farringdon Avenue, London, E.C.4, review the installations they make for augmenting existing natural draught or in new plants, the replacing of the usual tall chimney by a short one and an induced draught fan. The catalogue is available for all foundrymen on application.

Tubing.—We have received from Messrs. Earle, Bourne and Company, Limited, of Heath Street, South Birmingham, a souvenir booklet, which has for its object the giving to the reader a personal acquaintance with the works and organisation. We insist that this has been accomplished, as by means of splendid illustrations the reader is taken through the offices; the laboratory, where he has a peep into some of the results obtained; the metal stores; the melting shops; the power station; the rolling mill; tube mills; polishing and lacquering departments; fitting and tool departments; and welfare services. We congratulate the firm on its excellent production.

The Industries of the North-East Coast.

The recent convention of the Institute of British Foundrymen, held in Newcastle, provided such a range of works to be visited that it was impossible for members to avail themselves of the whole. We therefore append descriptions of those of direct interest to foundrymen.

SIR W. G. ARMSTRONG, WHITWORTH & CO., LTD. CLOSE WORKS, GATESHEAD-ON-TYNE.

The ironfoundry at these Works covers an area of six acres, and is adjacent to the L. & N.E. Railway, on which the Company has private sidings. The foundry is divided into six parallel bays, each approximately 540 ft. long, the pattern shop forming one flank.

The first bay is equipped with light moulding machines and is used for plate moulding; the second contains heavy moulding machines, and is reserved for castings up to 10 cwts., whilst the third is for castings up to 5 tons. Castings from 5 to 35 tons are made in the fourth, which bay has accommodation for the casting on end of hydraulic rams and cylinders up to 26 ft. long, and in the fifth bay the castings are cleaned and fettled before being dispatched. The fettling is done with the aid of a sand blast and pneumatic hammer equipment.

FIG. 1.—GENERAL VIEW OF THE NO. 4 BAY OF THE FOUNDRY OF SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LIMITED.

Each moulding bay is self-contained and is well equipped with the necessary core stoves and pug mills. The core stoves are all fitted with the latest pattern roller shutter doors, which can be operated quickly by one man.

In the lay-out of the melting section a unique opportunity presented itself for economy in labour. The storage sheds being 14 ft. above the foundry floor level, it is possible to charge the cupola direct with skips by means of the stock shed cranes, thus saving much handling. In the event of a crane breakdown during a heat, a balanced tipping bogie enables the heat to be completed with the aid of one extra man. The stock sheds have a storing capacity of 3,000 tons of metal and 400 tons of coke.

The foundry is supplied with molten metal from three cupolas at one end of the bays, and any cupola can supply direct to any particular bay by means of an electric bogie, which runs transversely the whole length of the shop.

The lay-out of the foundry is so arranged that the work is carried out with minimum handling and maximum speed of production, raw materials entering from the sidings at one end of the works and the castings being delivered at the opposite end to a car on the railway track.

All types of castings are dealt with, including automobile; Diesel; gas and oil engine castings from ¼ lb. weight upwards; locomotive; marine engine; hydraulic; general ship castings and lead works castings.

The Works have a weekly tonnage of 150, working one shift, and an average of 2,000 castings can be dealt with weekly. Four grades of refined pig-iron are made which are suitable for special work, the weekly output of this metal being approximately 200 tons.

The Pattern Shop.

The pattern shop is equipped with modern up-to-date machinery, and contains two 2-ton cranes for handling large patterns which are transferred to the foundry by a cross railway track. This department employs about 100 men on single shift.

THE WALLSEND SLIPWAY AND ENGINEERING CO., LTD., WALLSEND-ON-TYNE.

This Firm now possesses one of the largest and best equipped works in the United Kingdom. In the year 1871, it commenced with two slipways, and attention was confined to repair work only. Since that time, however, the extension of the Firm has been very remarkable in the general scope of its operations. From repairing ships, they went on to lengthen them, and from repairing engines and boilers they began to build them, with the result that the industry, as now carried on under the supervision of Mr. Andrew Laing, is a very comprehensive one. As the business has grown, the premises have been extended to meet its requirements, and in the year 1909 the slipways were dismantled, the land thus vacated having been since utilised for the expansion of the various branches of the business.

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The works now cover an area of 50 acres, and are in close proximity to the Point Pleasant, Howdon and Willington Quay Stations. They are connected with the North-Eastern Railway system by sid ways running throughout the establishment, and thus excellent railway facilities are available.

Bounded on one side by the River Tyne and on another by the Willington Gut, they are able to berth vessels of the largest dimensions having, as a matter of fact, half a mile of jetty accommodation. An electric crane of 200 tons capacity stands on the river wharf and shear legs of a lifting power of 80 tons overlook the Willington Gut berth. Travelling cranes of all descriptions for handling heavy weights are installed in the various shops and in different parts of the yard.

The fitting, erecting and boiler shops are of immense size. They are served with overhead travelling cranes of great capacity and contain up-to-date machinery capable of turning out the powerful types of engines and boilers which the Wallsend Company construct. The smaller shops also lack nothing in the way of modern tools and plant. Marine reciprocating, turbine and Diesel engines, cylindrical and water-tube boilers are all produced in the works. Installations for burning liquid fuel are manufactured in a department fitted up with the latest machinery and tools, which enables it to comply with the ever-increasing demands for the firm's system of oil burning.

Iron Foundry.

The main bay of the foundry is 200 ft. long by 50 ft. wide, and is adjoined by side bays 200 ft. long by 30 ft. wide. There is also an additional shop adjoining for light castings, which is the same length as the main bay and is 25 ft. wide.

The foundry is equipped with two electric overhead travelling cranes of 30 tons capacity, together with hydraulic and hand-jib cranes distributed throughout the shops where necessary.

Two cupolas, of 5 and 10 tons capacity respectively, are provided, air-blast being supplied by motor-driven blowers. There are four large core-drying stoves, and the department is well-equipped with the usual machinery in addition to a battery of mechanical dividing machines used in the manufacture of turbine diaphragms, in which the firm specialises. Castings up to 25 tons are made, the moulds used being in loam, dry sand and green sand.

Brass Foundry.

This department is 200 ft. long by 60 ft. wide. It is fitted with electric overhead travelling cranes, hand cranes being distributed throughout the shops where necessary. There are two core stoves. The foundry also possesses two jolt-ramming machines and two squeezer-type moulding machines actuated by compressed air. Castings up to about 2 tons are turned out by this department.

Pattern Shop.

The pattern shop, which is 200 ft. long by 75 ft. wide, is divided into two bays. It is equipped with the latest type of machinery, including sand-papering machines and a Watkin's woodworking machine. A sawdust extraction plant is fitted with connections to all machines and "sweep up" points on the floor.

Boiler-Making Department.

When the Company was founded, the boiler department was of very modest proportions, but is now capable of turning out the heaviest of boilers.

FIG. 2.—THE PATTERN SHOP AT THE WORKS OF THE WALLSEND SLIPWAY AND ENGINEERING COMPANY, LIMITED.

The shop itself is replete with the most modern appliances necessary for the manufacture of all types of boilers. Two large overhead cranes traverse the whole length of the boiler-erecting shop, each crane being capable of lifting 100 tons.

The shop also contains some very large machines for planing, rolling and hydraulic riveting. In order, however, to get an idea of its capacity one has only to note that the whole of the twenty-three double-ended boilers of the Cunard liner, "Mauretania," each weighing about 110 tons, were constructed in this shop.

The average output per annum before the War was seventy boilers of the cylindrical and water-tube type. During the War, this shop was kept very busy, 111 water-tube and 130 cylindrical boilers being manufactured.

Ship-Repairing Department.

One of the most interesting and important branches of the company's work is that of ship repairing, and the number of vessels on which important repairs have been carried out is legion.

The graving dock, which is 540 ft. long by 66 ft. wide, with 25 ft. of water on the sill, was opened

in January, 1895, and is one of the best equipped docks on the Tyne, being furnished with every requisite necessary for handling the largest repairs either to hull or machinery.

The steam yacht "Meteor" was in dock undergoing repairs at the time of the Foundrymen's visit, and attracted a good deal of attention. This ship was taken over from the Germans after the War, and is now engaged on pleasure tours from the Tyne to the Norwegian Fjords.

Oil Burner Department.

Over forty years ago the firm commenced research work in connection with the burning of liquid fuel, and since that time great developments have taken place in this department.

As a result of extensive and elaborate experiments which have been carried out, the system known as the Wallsend-Howdon patent system of burning liquid fuel has been evolved, and is now considered to be one of the simplest, cheapest and most efficient manufactured.

More than 800 vessels of all sizes and classes have been fitted by this firm with oil-burning installations. The system is applicable to either old or new vessels, and furnace arrangements can be made to burn oil only, coal only, or oil and coal combined.

The Wallsend-Howdon system has been installed in many ships converted from coal burning to oil burning, the double bottoms having been adopted for the storage of the liquid fuel.

Turbine Diaphragm and Blading Department.

In the early days of the marine steam turbine the firm at once saw its future possibilities, and immediately began to provide and prepare plant suitable for the manufacture of this type of engine. New machines for the boring of turbine castings and turning of rotors were laid down, and many other machines, appliances and devices were provided for cutting and shaping the turbine blading and fixing these blades in position. As a result of this enterprising foresight, and in consequence of the special plant they possessed, the firm was soon able to undertake for other engineering firms in the country the manufacture of detail parts, such as the cutting and shaping of turbine blading and the casting and machining of diaphragms used in the Brown-Curtis type of turbine.

Orders for these details from other firms have in recent years developed to such an extent that the Company found it necessary some time ago to form a new department to cope with this work. Possessed, as they are, with every modern and suitable appliance, they are able now not only to manufacture all the details connected with the turbines constructed at their own works, but also to supply the above-named details to many other engine builders.

The engineering department was in the early stages confined solely to repair work, and it was not until 1874 that the manufacture of marine engines and boilers really commenced. Since that time the progress in this branch of their operations has rapidly developed, the average production of new propelling machinery in the ten years ending 1896 being 26,145 horse-power. In the next decade the average had risen to 59,198 horse-power, and for the seven years prior to the war it had increased to 83,096. These figures, however, are insignificant in comparison with the output during the war period, which averaged over 300,000 horse-power per annum.

Among the most important vessels to be supplied by the firm with engines and boilers are battleships, including the H.M.S. "Queen Elizabeth" and "Malaya," cruisers, torpedo boats, destroyers, submarines, etc., and passenger liners, including the R.M.S. "Mauretania," which was fitted with engines of 70,000 i.h.p., and boilers, the latter having subsequently been converted to oil burning on the Wallsend-Howdon patent system by the firm.

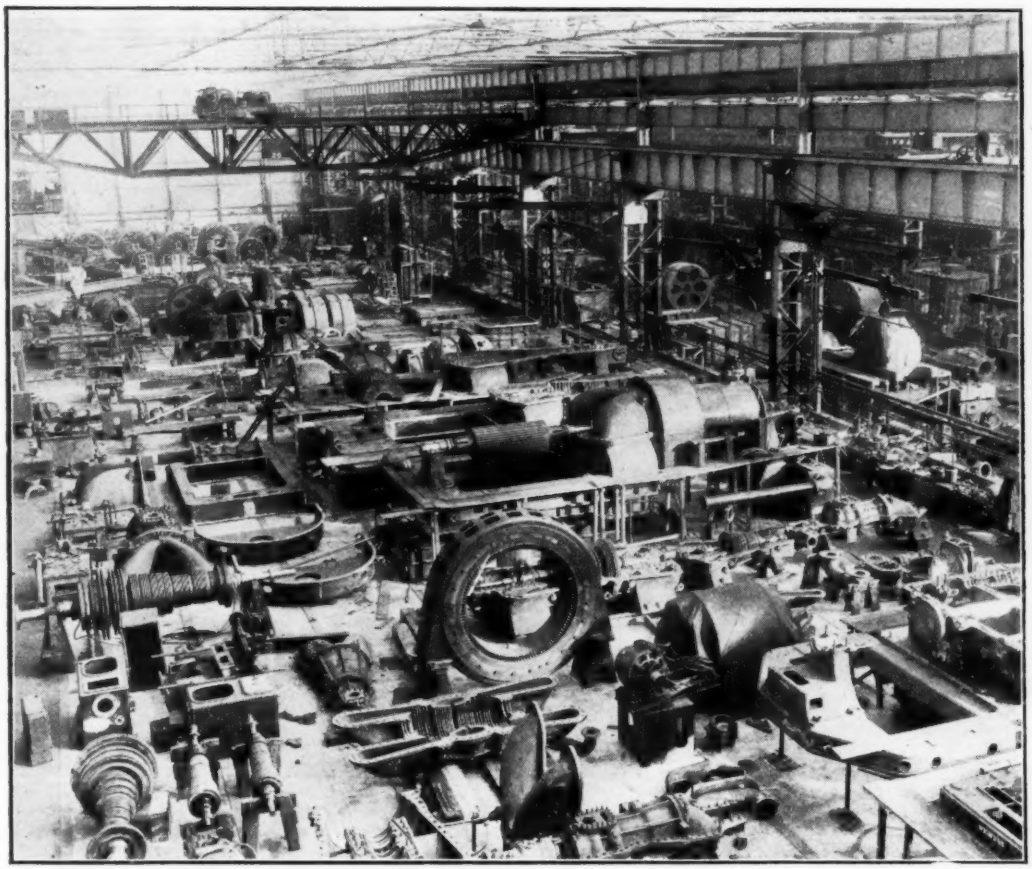


FIG. 3.—THE LARGE ERECTING SHOP BAY SHOWING THE THE ELECTRICAL WINDING SHOP AT THE FAR END, AT THE HEATON WORKS OF C. A. PARSONS & COMPANY, LIMITED.

XUM

THE HEATON WORKS OF C. A. PARSONS & CO., LTD., NEWCASTLE-ON-TYNE.

Historical.

In the year 1889 the Heaton Works were founded for the purpose of developing for land use the turbine and all classes of machinery which can be adapted to turbine drive. The first marine turbines were designed and constructed at Heaton Works in the year 1894, but in 1898 the Parsons Marine Steam Turbine Company, Limited, was formed at Wallsend-on-Tyne, and took over all the marine work.

In 1889 the Heaton Works covered an area of two acres, and the original shop was only 170 ft. long by 50 ft. wide. In this shop complete turbo-dynamos were constructed and erected. The pattern shop, blacksmiths' shop, testing room, etc., and offices all adjoined the main building, and the entire staff employed numbered only 48, all told.

The "Turbo" alternator was originated by Sir Charles Parsons at Heaton Works in 1889. In that year units of only 100 e.h.p. were being built, but in 1913 an alternator of 33,000 e.h.p. was constructed.

In present-day practice the power output at a given speed has been increased to more than five times what it was in 1913, when an output of 4,000 e.h.p. was considered very large for a speed of 3,000 r.p.m.; at the present time plants of over 20,000 e.h.p. at the same speed are under construction.

The Heaton Works To-day.

These cover an area of over eighteen acres, and employ more than 1,200 men. The standard manufactures of the works at the present time include the following:—(1) Steam turbines of all sizes up to 70,000 horse-power; (2) high-speed alternating current dynamos (or "alternators") for direct coupling to these turbines; (3) air coolers for the ventilation of the above alternators; (4) slow speed alternators for any prime mover; (5) mechanical speed-reducing gears to enable high-speed steam turbines to be utilised for driving slow-speed alternators or dynamos, also slow-speed mill shafts, either with or without ropes; (6) high-speed centrifugal fans, compressors, blowers, exhausters, etc., suitable for direct coupling to steam turbines; (7) surface condensing plant for steam turbine installations; and (8) searchlight reflectors.

It will be seen that, with the exception of the last item, these products may be summed up as the principal components of the modern engine room—whether in electric power stations, in collieries, or in mills and factories. The most important of these products, apart from the turbines themselves, is the alternating current dynamo or "alternator."

The Foundry.

Only small castings are made by the firm, the large ones being obtained from outside, but the iron foundry and brass foundry is kept in continuous operation, making the very large number of small parts required during the Company's yearly output of complete plants. This shop is well-equipped with the necessary annealing furnaces, etc., and is particularly suitable for the production of castings up to three tons. The pattern shop, which is a building separate from the rest of the works, is capable of making all the patterns for the Company's manufactures.

FIG. 4.—THE PATTERN SHOP AT THE HEATON WORKS OF C. A. PARSONS & COMPANY, LIMITED.

Adjoining the foundry is the blade-rolling shop, and then comes the blading and brass shop, the former preparing the rolled material for the latter. These three shops, which were built in 1912, form one building, and at the present time are being extended to a total length of 277 ft. 6 in.

Large Machine and Erecting Shops.

The principal shops, consisting of four bays, each 385 ft. long, are devoted to heavy machine work and general fitting and erection of complete plants.

The first two bays, nearest to Shields Road, which are each 40 ft. wide, were erected in 1899, and a third similar bay was added on the north side in 1910. This shop became the principal erecting shop, one end for complete assembly of machines, whilst the other was entirely taken up with electrical work, including the winding and erection of alternators and exciters.

In 1919 the fourth of these bays was built, but it was made wider (80 ft.) and higher to enable the very largest plants to be dealt with. This shop, which has now superseded No. 3 bay as principal erecting shop and armature winding shop, was filled with work very soon after it was completed. The total length of the shop is 416 ft.

Balancing House.

This is situated close to the armature winding shop, and has specially thick concrete walls. Alternator rotors are run up and tested at 25 per cent. above normal running speed and also accurately balanced before being despatched.

Test House.

A test house and boiler plant were installed in the works in the earliest days, but in 1899, the original being found entirely inadequate, a new house was built on a much larger scale. It has already been extended in length, one end being devoted to the packing and despatch of the completed machines.

The Old Shop.

The original shop, which has been extended twice and now has a length of 350 ft., is devoted to small machine work, the construction of valve and governing gear for the turbines, and to the preparation of soft iron core plates ready for use in building up alternator armatures or "stators."

works apprentice scheme which had been in operation for many years. Practical and theoretical instruction is given, and the custom of the welfare department is to put every "trade" apprentice through the course at the school and also to encourage further study at evening classes and at college by suitable financial aid.

Nearly all the various shops at the Heaton Works are interconnected by full gauge railways, which are electrified by the overhead wire d.c. trolley system. Power for the works is now supplied mainly externally by the Newcastle-on-Tyne Electric Supply Company, Limited, from Carville. A sub-station in the Heaton Works transforms the 6,600-volt supply down to the 440-volt service used in the shops. Direct current is also available for driving many of the motors and for the entire lighting of the works from a motor converter set on the ground floor of the same sub-station.

The Offices.

The main office building, which was built in the year 1899, was extended in 1911 in order to provide greater accommodation for the drawing offices and various technical departments.

The ground floor of the building is devoted to the administrative offices and general office.

The greater part of the first floor is devoted to the turbine design departments, and the corresponding space on the floor above is taken up by the general drawing office staff, who prepare foundation

FIG. 5.—THE IRONFOUNDRY OF THE WALLSEND SLIPWAY AND ENGINEERING COMPANY, LIMITED.

The Electrical Insulation Shop.

The insulation materials, which form so vital a part of electrical machinery, are prepared from the raw material entirely in the works. This department adjoins the electrical shop, and is specially ventilated and free from dust. The stranded conductors for the alternator stators are built up to any desired cross section, and encased in insulating troughs by special machines evolved at Heaton Works.

Mirror Departments.

Searchlight reflectors have been one of the Company's standard products since the foundation of the works in 1889, and they are manufactured in bays situated in the south-east corner of the site: the roofs, being of the weaving-shed type, giving a good north light. Besides supplying the British Government, large numbers of mirrors have also been supplied to foreign governments and private firms. This department is probably the largest of its kind in the world, and during the war the shops were enlarged to three times their previous capacity and the output increased ten-fold up to 100 mirrors per week, ranging in size from 10 in. up to 5 ft. in diameter.

Other Departments.

Other important departments of the works include a large tool room, several experimental shops, electrical and metallurgical laboratories, materials testing room and stores. There is also a welfare department, ambulance room, canteen and works school for apprentices. The latter was commenced in 1919 as a natural development of the

work drawings and general arrangement schemes for the complete installation of turbo-generator plants on site; by a printing room for the preparation of prints, and a tracing office.

The record of the Heaton Works is one of continuous pioneering work in the field of mechanical and electrical engineering. The actual products of the Company, as manufactured to-day, can give but a small idea of all the various ideas and devices that have been tried and experimented with in the constant search for progress. These products, however, always embody the very latest and best practice.

The Heaton Works have two very important contracts in hand at the present moment. They are busy constructing a 50,000-kw. turbo alternator for the Commonwealth Edison Company, of Chicago, this being the largest plant of its kind ever constructed in this country. They also have under construction two 10,000-kw. turbo alternators for the Barking Power Station of the County of London Electric Supply Company, which when completed will be the largest turbo alternators in operation in this country.

Other Works.

Other important works visited were the North Eastern Marine Engineering Company, Limited, Wallsend; Messrs. Smith, Patterson & Company, Limited, both of which works have been described in THE FOUNDRY TRADE JOURNAL. Works other than engineering works which accorded facilities were the Redheugh Gas Works, Gateshead; the "Newcastle Chronicle" office; Messrs. J. Dampney & Company, Limited; etc.

XUM

Discussion on Foundry Trades Exhibition Congress Papers.

Liquid Contraction in Grey Cast Iron.

By ROBERT BUCHANAN.

Opening the discussion, the Chairman (Professor F. C. Thompson, of Manchester) said he was surprised to hear Mr. Buchanan say that engineers objected to the use of chills for densening portions of the metal. With regard to Mr. Buchanan's reference to the use of manganese, Professor Thompson remarked that in so far as the manganese cut down the size of the graphite plates it was emphatically performing a useful service, but as to its effect on sulphur it was a question whether it was better to reduce the sulphur content by manganese, or by the addition of soda ash in the cupola itself. The reference to volume changes due to graphite raised the old question of where exactly the graphite came out. He believed it was still uncertain as to the exact nature of the precipitations of graphite, for that there were more than one was perfectly clear. Until they knew the exact conditions under which the graphite came out, progress, both theoretical and to a considerable extent practical, would be seriously retarded.

Small Runners.

Mr. Joseph Hogg (Manchester), discussing why slow pouring resulted in dense castings, said that while he granted that some parts of the casting being poured were cooling before the total quantity of metal filled the mould, he had often wondered whether to some extent the density of the casting was not due to the fact that the gases had a longer time to escape from the mould during the pouring. He mentioned that a short time ago he visited a fairly large foundry, where the man in charge was a first-class foundryman, but where the only assistance he had of a metallurgical character was the analyses of the irons used. The man was engaged on cylinders for a special stoker job, and he had had a great deal of trouble with them, arising from blow-holes just beneath the skin. The castings were about 15 cwt. He adopted the Ronceray method, using two pencil runners instead of the ordinary V gate. Looking at the gates, it appeared impossible that the castings could be run. They were run, however, on one flange, and were a perfect success in every detail. There was no sign of blow-holes, and they had all been machine bored. Mr. Hogg believed many engineers had complained of the use of denseners. He understood that in the latter part of the war regulations were issued by the engineers to the effect that only so many denseners were to be used and only in certain parts, and at the same time engineers were asking for castings totally cast in permanent moulds. He contended that they ought to be allowed the use of denseners where the foundryman thought that they would assist him. He was a confirmed believer in the use of denseners, because certain castings, especially those that required machine threads to be put on, were better cast in soft metal, and certain sections had to stand hydraulic pressure.

Mr. V. C. Faulkner suggested that the difficulty experienced with the cylinders referred to by Mr. Hogg had nothing to do with liquid contraction. He would rather ascribe it to blow-holes originating from the sand.

Mr. T. Turner, junr., said the explanation given by Mr. Buchanan regarding liquid contraction in one part of the casting being due to the solid expansion of another part or parts was not very clear to him. Since the graphite particles were so small the expansion, he said, must be taking place at different times, and could not be one wave movement right through.

Inherent Properties Affirmed.

Replying upon the discussion, Mr. Buchanan said he agreed that denseners were not only very useful but an absolute necessity in ironfounding to-day. Discussing whether if the graphite flakes were large in the pig they were likely to come out large in the casting, Mr. Buchanan said it depended on the melting conditions and the kind of casting they were running. While many chemists laughed at the idea of heredity in iron, he rather thought there was something in it. If they were dealing with large graphite in the pig, under suitable conditions—which was rather a qualifying phrase—they could get a repetition. Dealing with Mr. Turner's remarks, he said he had no doubt at all that the carbon came out while the iron was solid, but in a plastic condition.

Mr. Buchanan was warmly thanked for his address.

A Comment Upon the Methods of Judging and Mixing of Pig-Iron.

By H. P. YOUNG, F.I.C.

Opening the proceedings, Mr. J. S. Pearson, as Chairman, said that as a long time member of the Birmingham Iron Trade Exchange and one-time President, it was very gratifying that the Congress had chosen one of their members to initiate the conference. He understood that Mr. Young could not attend, and therefore Mr. Faulkner would read his Paper. Personally he should be very pleased to hear any suggestions that would be of assistance to the foundry trade, and the iron trade in particular, in relieving it from the present period of depression, and if Mr. Faulkner could explain to them that English pig-irons were better than foreign, he thought it would be of material help to the trade at a time when it sorely needed assistance.

The Universality of Science.

Mr. V. C. Faulkner, prefacing the Paper by a few remarks, said it did not go into the question of the superiority of any class of iron; but what Mr. Young, who represented pure science, did state was that pig-iron was best judged by its chemical composition and not on any other basis. After a long friendship with Mr. Young, he thought he could say that the author's unstated belief was that the foundry should not have for itself its own philosophy, nor should the steelworks, nor should the refractory materials industry; but that true science was common to every branch of industry. He believed that Mr. Young regarded it as a misfortune that the foundry trades were building around themselves their own separate philosophies and their own science. He (the speaker) might be wrong, because Mr. Young had not said this to him, and he had only gathered it from a fairly close study of his writings. Having read the Paper to a representative audience, Mr. Faulkner said he thought the time was approaching when pig-iron would generally be bought and sold on analysis. Although Mr. Young did not state this in his remarks, he was quite sure that large quantities were being sold at present to analysis. He had just seen a stock list of 3,000 tons, all of which was graded, and, he presumed, accurately analysed. Most firms, he believed, would now give an analysis with some degree of dependability, and perhaps the conditions were not so bad as Mr. Young would have them painted.

Chemical Conditions Require Standardising.

MR. R. BUCHANAN, observing that Mr. Young was fond of using the big hammer, said he proposed to leave the non-ferrous section of the Paper alone, because he knew little about it. As regards his plea that analysts should have full control of the purchase and use of pig-iron, he thought the chemists and analysts required first of all to put their house in order. Only that day a foundryman told him that his chemist could not obtain results concordant with those of the pig-iron people. But hunting the matter down to its ultimate, it was found that each was correct

according to his own standards, for the standards were dissimilar. Consequently it was impossible to secure agreement between the two laboratories, as they were working from a different basis. Until chemists found a common base from which to work they could scarcely be surprised if their pig-irons and castings were found to be dissimilar in analyses. It was, of course, well known to all of them that there were differences in the physical results obtained from irons of similar analysis—at least as similar as the chemists could state. Years ago there was a case, which was widely known, in which a Swedish firm wanted to increase their output from the blast furnaces, and departed from the usual methods and employed more air and more fuel. But while they repeated the analyses in the new iron to coincide with the good iron hitherto obtained, the physical characteristics of the latter were found to have disappeared, and the firm had to revert to their old methods. He was assured that a similar experience occurred in this country, and he would like Mr. Young or somebody else to tell him what did happen when they had two similar analyses with different physical results. Mr. Young had referred to the standards which were evidently different in various laboratories. It was rather significant that the National Physical Laboratory was now open to distribute standards for each of the elements in cast iron, so that they might expect that accuracy which Mr. Young at present claimed, but which he (the speaker) said did not exist. First of all, therefore, it was necessary before criticising the foundryman or the blast furnacemen that the chemists should put their own house in order. Then they might be able to rely on the doctrine that with similar analyses they could obtain similar physical results. Mr. Young paid a considerable compliment to those interested in the sale of pig-iron by saying that the state of mind of foundrymen had been formed in part by long and skilful propaganda written cunningly in scientific-looking language; but he himself was bound to confess that he had not met these men, and would be glad to be introduced to some of them for his own information. On the question of fracture, which Mr. Young had dealt with, he would ask how was the chemist or analyst going to inform them of the temperature at which the pig was run into the mould? There was, of course, a certain amount of truth in the lecturer's contention that it was beyond human power to judge differences in the fracture of pig-iron with accuracy. But he knew a man in charge of four cupolas who was melting over 100 tons a day, and who assured him that he would prefer to have a different analysis than a difference in fracture, and that man worked on that basis. This particular man certainly secured partial analytical control and also partial fracture control, and, moreover, he obtained his tests. He did not claim that this was a correct method, but it was being done with fairly satisfactory results—the fracture being as closely examined as the analysis.

Commenting on the statement of Dr. Stead as to the building up of pig-iron synthetically, which would give concordant results all along, the speaker observed that the Doctor was such an eminent man that he should not wonder if he could do this, but that ordinary foundrymen could do so he was more than doubtful. Mr. Young had given expression to a somewhat alarming statement in saying that the average foundryman, including the one with a small laboratory, had no idea of the difficulty of the task of making two castings alike in composition from different pig-irons. He also said there were few laboratories doing accurate mass analysis of cast and pig-iron, and that the graphitic and combined carbons were estimated accurately very seldom. Now if a laboratory with two chemists could not make the required iron for the cupola so as to obtain the castings desired, then he should say it was a pretty hopeless case. If he had two chemists at his disposal, he should expect quite good results. But there were very few foundries which could afford a chemist to-day, not to mention two chemists. Mr. Young seemed to be looking for paradise on this side of the grave, and his view was that the lecturer was not likely to live in such a happy state. Concluding, Mr. Buchanan quoted Mr. Young as to efficient grading and mixing being the only medium of accurate and complete analysis, and claimed that under present conditions the chemist was no more accurate than the foundryman. When the chemist had re-ordered his own department, they would be only too pleased to hear the criticisms he had to offer.

Co-operation Emphasised.

MR. W. H. POOLE (KEIGHLEY), speaking as a metallurgist, said he totally disagreed with the manner in which Mr. Young had tackled the problem. There was one simple but important word which the writer seemed to have forgotten, namely, co-operation. There was, whatever was said, something to appreciate and acknowledge in the foundryman's method of rule of thumb, and the judging more by fracture than otherwise had certain merits which must not be under-estimated. From his own experience as a metallurgist, he might say that he made invaluable use of the fracture, but he took care to back it up by analysis. However, on the question of the accuracy of their analyses he did not go quite so far as Mr. Buchanan in his criticism.

Importance of Sampling.

There had been no mention of one vital factor, that of sampling. Of course, the sampling of a batch of pig-iron was a very tedious although important matter. For example, suppose one took 20 or 30 samples in 20 tons of pig, no matter how carefully the sampling was done and redone, they were almost certain to get some discrepancy in the analysis, perhaps 0.02, 0.03, or 0.05 per cent. But one had to take a broad view on this question of agreement with the analyses of pig-iron manufacturers. He had found some remarkable cases of differentiation as to the amount of variation permissible. Recently one firm guaranteed an iron of 2.25 per cent. silicon; a dozen deliveries were tested, and he was unable to say that the manufacturer was wrong. Some of them were trying to be as open-minded as the foundrymen. One had to appreciate the difficulties of the manufacturers as well as of the men who used their material. If consideration were fairly given to both points of view one would not, he suggested, be reading statements put in such a blunt and unqualified way as appeared in the Paper they were discussing. He wished Mr. Young were present so as to help matters forward a little more. He had found among practical men no lack of consideration towards the work of the metallurgist and chemist. From the point of view of mutual benefit, he suggested that it was a mistake to argue with a manufacturer about the percentages of an analysis. In one case where 3 to 3½ per cent. was given, they found the percentage came out at 8 per cent., but they did not inform the seller that his analysis was hopelessly wrong: they simply asked him to come over and sample it himself. He had yet to find an instance in which a matter of this sort was not considered on broad lines, and some arrangement made in consequence. Further, it was his experience that if they particularly called for a definite standard they could generally secure it. This, he thought, showed that the blast furnaces and the foundries appreciated the work which the metallurgist was doing.

An Undrillable No. 3 Iron.

On the question of fracture analysis, if they studied the matter at all deeply a great amount could be learned. He had come across an interesting case in which No. 3 pig-iron was ordered. It was a widely used term which denoted an open grade of iron. But when drilling was tried for sampling purposes four out of six samples could not be drilled. However, they managed to crush the samples, and the analysis was perfectly normal, even to the total carbon content which Mr. Young had emphasised in his Paper. Yet even the foundrymen complained of hard spots in the castings due to this particular quality of pig. Under the microscope the logical explanation was at last forthcoming. Under a certain carbon condition they obtained a structure showing one of the hardest forms of carbide, and what had happened here, so it proved upon full investigation

reaching to the blast furnace, was that the hose pipe had been turned on at a critical temperature of the pig, which prevented graphitisation, and so affected in an adverse way the open fracture expected. That pig when re-melted was apparently normal, and thus presented a case where both fracture and analysis required deeper investigation.

A High-Silicon No. 3 Pig.

In another case a man was using No. 3 foundry pig, and had never had it analysed. Finding the castings badly drawn, quite logically he altered his mixture, using more scrap and less pig. It looked very hard. The man thought he could use 75 per cent. scrap, and upon testing it found he had a high silicon pig. There one had a case where a metallurgist, much as he might be found a nuisance, could have been of great help. Another matter which Mr. Young had not explained was the melting condition. He agreed with Mr. Buchanan that one could produce pig-irons of similar analyses which on re-melting gave different results; one batch might be perfect, and the other might melt very hot but chill off in the ladle before being tipped out from the spout. There were instances where melting conditions had produced abnormal types of pig, and blast furnaces, he thought, appreciated the conditions under which it was made. As to carbon control, he endorsed the contention that it was of vital importance.

High-Carbon No. 3 Pig.

Again, in some No. 3 pig used on locomotive cylinder work, there had been endless trouble. Investigations had followed regarding the silicon, sulphur, phosphorus, manganese, and total carbon of nearly 4 per cent. The man in charge had previously used a metal of 3.02 per cent. total carbon. The iron was sold with the silicon content as correct, but it had a strong charge of graphitic carbon. The conclusion one might have adopted was that one should go to the blast furnace and ask for an iron which was not rich, so that one could get a close grained texture and a perfectly good fracture. Reverting to the man who added more scrap, Mr. Poole said he found that his quality did not come out hard because he did not take account of the melting conditions, and in conclusion he urged buyers and foundrymen to be rather more open in regard to what they wanted in pig-iron. In ordering No. 3 he found that in connection with the silicon content one could get a very open pig at 2½ to 3 per cent., or a very close-grained pig. The total carbon content formed a very important factor in the casting in a fine-grained pig. With 2 to 2½ per cent. silicon in a close-grained pig, the difference in the two was tremendous; one had nearly 4 per cent. carbon and the other nearly 3 per cent.

MR. M. E. GALLON explained that before Mr. Young was further misunderstood he should state that the lecturer had as great an appreciation of the value of co-operation as anyone present between the foundryman and the chemist. Mr. Young was certainly no lead pipe swinger, for although he put things bluntly he was quite broad-minded, and was always ready to help anyone. Although at one time foundrymen thought they knew a great deal, they had found from experience that the chemist was their friend; indeed, the one could not do without the other.

MR. FAULKNER also observed that in so much as Mr. Young had been called a lead pipe swinger, he thought it right to say that if they would only look at the Paper in its proper light they would realise that had the author dealt with co-operation there would have been no discussion. Mr. Young probably put things in such an uncompromising manner to stimulate discussion, which was what was required.

Clumsy Chemists.

MR. J. E. FLETCHER thought that in the main Mr. Young was right. Unless they paid more particular attention to the exact, complete composition of pig-iron they would go very seriously wrong. No doubt, as Mr. Poole had mentioned, they must take account of the cooling conditions of the pig-iron as produced, and in the examination of any casting it was also necessary to take into account the mass cooling effect of the metal. Those of them who had read the writings of Mr. Young would realise that he had taken a very particular interest in the question of cooling and of mass in its effect on the ultimate strength, composition and on the structure of cast iron. It might be necessary, and was in some quarters, for the chemist to put his house in order; and, as Mr. Buchanan indicated, there were far too many clumsy analyses, and if such analyses were supplied to the foundry they were very misleading. On the other hand, if the analyses were right, then the foundryman was furnished with a tool which was satisfactory, and was as useful to him as any tool which they knew of at present. So far as sampling iron was concerned, there was a very great difficulty in arriving at a proper sample. Those who had been associated with blast furnace work knew that there was a considerable variation in every cast. It was only by very careful examination by those who were acquainted with the history of every charge at any particular blast furnace that pig-iron could be properly tackled. He was personally grateful to Mr. Young for having so boldly set forth his ideas, because he believed it was only in that way that they could obtain helpful discussion of this nature which would lead them to think on right lines. He could fully support Mr. Gallon in his statement that no man had a greater eye for the advantages of co-operation than Mr. Young, and anyone who had visited his works could not but be struck by the close co-operation that existed between him and his foundry manager. The great success, as anyone could see for himself, of the way in which he managed the manufacture of pig-iron was largely due to this factor.

At this stage MR. POOLE interposed with an explanation that he knew Mr. Young quite well, and had a great admiration for his work. His remarks were in no sense personal, and, of course, many of them had different methods of tackling various problems. No doubt Mr. Young had vastly assisted in raising the chemist to the position he occupied to-day in this country.

The Limitations of Chemistry.

MR. F. J. COOK, while expressing his appreciation of the work done by Mr. Young, said that anyone reading between the lines of his Paper might well think that he did a great injustice to the chemist. He condemned so many chemists for slack methods, and so forth, that they might come to the conclusion that they were really better off without them. He quite agreed with the necessity for accurate and full analysis, but he could hardly go with him to the extent that when one had obtained the analysis one had reached the alpha and omega of cast iron. He might refer them in this respect to a little research done by himself to which Mr. Young had never been able to give an answer: of two irons which for a long period had absolutely identical analyses, so far as one could practically get them identical, the one showed very different physical properties from the other. It was useless to say that those analyses were not correctly taken, because they were done by three independent persons. He was not condemning analysis, because it was the foundation of all scientific work, and was of very great value to the man who worked with a particularly strong grade of iron. But he insisted that the chemists had yet a long way to go, and had to know a great deal more about analyses than they did to-day. They knew very little of the actual conditions taking place in the blast furnace, for they might get two irons of similar analyses and yet find that their physical structure and properties were widely different. And a man who relied on chemical analyses alone was working on a weak bottom: it was only one of the foundations they should use, and admittedly a very useful one, but there were others which they must utilise in producing a high-class metal.

Faulty Sampling and Inaccurate Analyses.

MR. ARTHUR MARKS said he had listened to the Paper with considerable pleasure and also with some amazement. He was afraid he could not agree with many of the statements which were made by the writer. He spoke not only as a chemist, but as a practical foundryman also, and

therefore claimed to be able to appreciate both sides. The cast-iron industry, they must remember, started, like many other things, from the practical side, and the scientific aspect had gradually come in to help it along. At present both these factors were in a fairly highly developed state, and as regards Mr. Buchanan's comments that the chemist should first put his own house in order, it appeared to him to be somewhat wide of the mark. After all said and done, chemists could analyse very accurately. But in firms with which he had been associated—and this had a bearing on some of the remarks made by Mr. Fletcher—the practice had been to pass, say, three pieces of pig-iron, taken from perhaps 10 to 20 tons of metal at the discretion of the labourer, and these were sent up as samples for analysis. He would like to emphasise the need for accurate sampling, for as a practical proposition accurate sampling was not done in this country in the cast-iron industry. If they desired an education in sampling, they could not do better than visit the copper ore yards at Swansea and district. They would then get to know the reason why there were so many ridiculous comments made regarding the work of chemists. It should be the rule that to obtain a proper chemical analysis which could be used and relied on chemists should first be assured of an accurate sample. As a practical foundryman, however, he was not so much concerned with accurate analyses, which had their limitations. If, for example, they charged a calculated mixture into the cupola, and did not recognise the fact that the job was going to be run cold or hot, they were going to obtain two entirely different products, and these products would be different in analysis. In many engineering works to-day the chemist engaged was a youth who was trained up to do a certain amount of mechanical analysis, and chemistry was suffering a good deal from that practice. Moreover, analytical results were handed to the engineer, who did not appreciate their true significance; whereas an expert, knowing the meaning beneath an analysis—which to the uninitiated appeared to be identical with another, but which were as different as chalk and cheese—would be able to draw the proper working conclusions. This was a factor which was the cause of so much scorn being poured on scientific work at the present time. It took a trained man in science with a working knowledge of the foundry to transpose an analysis into practical results such as were required, and the average engineer was not capable of doing this. He thought that while it was good for Mr. Young to advocate the analytical side of the problem, it was also wise to remember that immediately an analysis left the laboratory and the pig-iron went to the cupola, the whole analysis could be washed out by the entirely different conditions under which the cupola was working. In cast-iron graphite was probably the most important element, but as an analytical item it could not be exactly estimated. However, it could be estimated with a reasonable degree of accuracy. He thought that when they secured better co-operation between the manufacturer of pig-iron and the metallurgist and practical foundryman, they would be able to get over these difficulties. But for one side to claim all the scientific knowledge and for the other side to claim all the practical knowledge was ridiculous, and they would not advance very far until that idea was wiped out. They should not be too dogmatic. While one appreciated Mr. Young's good work, they also desired to acknowledge the solid work done in the past by foundrymen, who had only their experience to guide them. The Paper had caused a stir-up amongst foundrymen, and they must all appreciate what Mr. Young had done to bring together the practical and scientific sides of the industry.

MR. G. E. WHITEHOUSE, who for the past 27 years has been the Birmingham representative of Settle, Speakman & Company, Limited, has just retired, and carries with him the best wishes of a wide circle of friends. Mr. S. H. Hotchkiss, who is very well known in all branches of the trade in the Birmingham area, has been appointed to succeed him in the management of the Birmingham office.

Institute of British Foundrymen.

LANCASHIRE BRANCH.

On Saturday, June 28, the members of the Lancashire Branch visited the works of the Sheepbridge Coal & Iron Company, Limited, near Chesterfield. They were met at the Chesterfield Railway Station by officials of the company, and conveyed to the works in 'buses. After witnessing the tapping of a blast furnace, they toured the works in small groups, each group being accompanied by two members of the staff. The methods adopted in the making of sand-cast pipes, and the machine for running pipe moulds, attracted considerable attention, and another item of particular interest was the Meredith engine for compressed air or steam. This engine, an invention of a member of the staff, is being used among other purposes for the driving of colliery haulage gears.

At the conclusion of the visit the visitors motored to the Station Hotel, Chesterfield, where they were entertained to lunch by the Sheepbridge Company. A welcome was extended to them by Mr. T. E. Haslam, the secretary of the company, and by Mr. J. H. Goodwin. The thanks of the visitors were expressed by the Branch President, Mr. R. A. Miles, and the Branch Secretary, Mr. T. Makemson. Among those present was Mr. R. Buchanan, Past-President of the Institution.

Junior Section to be Formed.

After the lunch a meeting was held for the purpose of considering the question of a junior section.

The President, Mr. Miles, explained that a sub-committee recently appointed had been considering this matter, and had recommended that a junior section be formed. The Branch Council accepted that recommendation, and the next step was for the members to say whether they confirmed or rejected the proposal.

Mr. T. Makemson added that it was not intended that the junior section should compete with existing foundry education facilities; it was rather intended to create an interest which would induce the younger members of the trade to take advantage of those facilities.

Mr. H. Stead moved that a Junior Section be formed. The motion was seconded by Mr. W. Gilpin and carried unanimously.

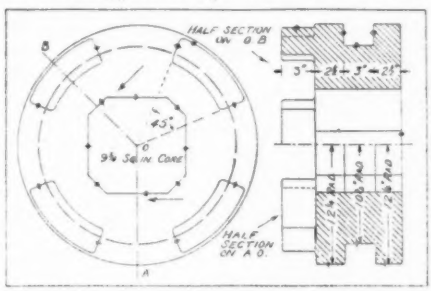
On the proposition of Mr. Mallett, seconded by Mr. J. Masters, the following gentlemen were elected a sub-committee to draw up rules for the new section:—Messrs. S. G. Smith, Jolley, Key, and R. W. Stubbs, with the Branch President and Branch Secretary.

Mr. J. H. Goodwin gave an account of the work of the British Cast Iron Research Association, and asked that it be supported.

Foundry Queries.

Cast Steel Friction Clutch.

We have a number of clutches to enclosed sketch which have to be made in cast steel. We would much appreciate opinions as to the best way



to run them, also the approximate position, number and size of heads required to ensure sound castings.—E. M.

Bed Plate Castings.

We understand that there is a method of making bed plate castings weighing anything up to 1 or 2 tons, without the use of a pattern or, we believe, even a strickle. Can any reader give us an idea of how this is done?—T. F. C.

German Society of Foundrymen.

At the recent fourteenth annual meeting of the German Society of Foundrymen in Berlin, a number of interesting papers were read and discussed, of which the following are brief extracts :—

Electric Furnaces in the Foundry.

Herr E. Kerpeley, of Jenback, read a paper on "The Electric Furnace in the Iron Foundry." The present economic position in Germany has raised many new problems for foundries. World competition, the shortage of fuel, continual increases in tariffs, and the high percentage of sulphur present in cast iron have rendered it necessary for foundries to seek cheaper methods of production. In this connection a great deal can be done by the use of the electric furnace, because it enables foundries to be run satisfactorily and economically.

The principal—almost the exclusive—type of furnace used for the purpose is the arc furnace, which can also be recommended for working on liquid charges. The author has already contributed a paper to the *Giesserei-Zeitung* on arc furnace design, and in his present paper he referred to the advantage of the furnaces being placed as high as possible above the foundry level so as to enable the furnacemen to take the iron required direct from the furnace by means of a swivelling ladle. Further points raised were that the size of the furnace should be selected in accordance with the production and the size of castings made. As regards the actual process, three methods can be adopted—(1) for smelting only; (2) with the combined process, and (3) for the synthetic production of cast iron.

In the firt case, only scrap pig is melted, the current consumption ranging from 350 to 400 kilowatts per ton. The melt is kept on the acid side so as to keep down silicon slagging. The alloy elements prescribed according to the quality of metal aimed at can be easily regulated The process can also be used with broken pig of poor quality, especially where a cheap supply of current is available.

The combined process can either be used with a cupola or reverberatory furnace, and the metallurgical process is very simple in character, the current consumption being from 100-150 kilowatt-hours per ton. A comparatively small plant is capable of a very big output. This process is applicable as well to the production of a large number of small and light castings. Although the melting costs are low, this method of working requires extremely careful consideration.

In the production of synthetic cast iron the advantages of the electric furnace are utilised to the full. The process is entirely independent of pig-iron and scrap. The writer refers to the production of high-silicon iron (12 to 14 per cent. Si) for certain sections of the chemical industry, and to the possibility of the method for producing hard castings. He also gives a description of the method of running a modern electric furnace plant devoted exclusively to the production of different types of synthetic cast iron. A description of a carburising method is given in which the guaranteed carbon content in the cast metal is from 3.5 to 4 per cent. In the melts carried out in the plant described every expectation of this process has been more than justified: the process of synthetic cast iron is profitable, and for Germany, where economy is now the order of the day, the author highly recommends it.

Production of Electric Steel Castings.

Herr Hubert Hermanns, of Berlin, read a paper on "The Technical and Economic Bases of the Italian Iron and Steel Industry, especially the Production of Electric Steel in the form of Mould Castings." The author described his experience of visits to the majority of the Italian steel and iron works. From the economic standpoint, Italy's steel industry rests upon her tremendous reserves of water-power, especially in the Southern Pre-Alpine region, which have been developed considerably both during and since the war. In 1913, 2 million horse-power were available in the country, some 80 per cent. of this being water-power. In 1922 the power available was 1.8 million kilowatts, some 1.24 million kilowatts being water-power. Owing to the cost of electric power, electric steel can be produced much cheaper than can open-hearth and Bessemer steel. The last-named process has never attained any importance in Italy, owing to the small amount of iron ore mined. Even the process using small Bessemer converters has been adopted in very few steel works. The chief types of electric furnace in use are the Héroult and the Fiat, with capacities of up to 15 tons. All kinds of steel are produced in the electric furnace, from the ordinary commercial sorts to the most expensive alloy steels. Although the Italian technical colleges are not up to the German institutions, the Italians seem to have been able to train a sufficient number of metallurgists to meet their requirements. Italian foundrymen and furnacemen are not behind the German in any respect, but the same cannot be said of the hand moulders, due to lack of proper training. Women are largely used on moulding machines and for core-making. In conclusion, the writer states that, with the developing of Italy's water-power resources of the present rate, which will enable 1 million tons of electric steel to be produced in 1928, it is to be expected that Italy will be able to increase the lead she now holds over other nations in the production of electric steel. It is questionable, however, whether the Italian industry will be able to absorb such a large output.

Arc Welding of Castings.

Dr. W. Achenbach, of Berlin, read a paper on "Arc Welding of Castings." The chief admixtures of iron not only affect its quality in the form of castings, but also its weldability by the arc method. The very high temperatures prevailing give the welds a much finer structure than that of the initial material. The result is that the weld has a higher mechanical strength than the unwelded portions. This extra strength can, however, only be utilised when the enormous shrinkage tensions are equalised, as the strength of the weld is not always able to stand up to them. Special attention then must be directed to internal stresses, which can be restricted by skilled work, selection of the proper process and by heating and annealing.

The nature, size and value of the damaged castings have led to considerable development in the number of welding methods, so that at the present time it is possible in nearly every case to say with certainty which is the best process to use. The hot-welding method (using the electric arc) is the newest, and the one which presents most possibilities, but at the same time the cold-welding method, using steel and iron electrodes, has been greatly improved.

System in the Foundry.

"System in Hand and Machine Moulding" was the subject of Herr J. Petin's (Hanover) paper. By system in this connection, the author means systematic division of work into mental and manual work, or preparation and execution. System here, as in other branches of industry, leads to reduced cost of production and enhanced quality of the product.

System really commences with proper subdivision of the working plants and the maximum efficiency on the part of labour. To this group of ideas belong that which strives at the maximum utilisation of the moulding surface, careful arrangement of mechanical transport, etc., and careful separation of productive and unproductive labour.

In hand and machine moulding, system can be applied under the following headings:—(1) Maximum utilisation of the skilled moulder for purely productive purposes; (2) suitable planning and properly prescribed operations. This can best be done by dividing the work into preparation (mental work) and execution (manual work).

In hand moulding, the selection of the moulding boxes is of prime importance. They should be as light and handy as possible, this applying in particular to the folding type of box. Further, the moulding devices should be as practical and simple as possible, so as to keep pace with the output from moulding machines. Relief moulding boards should be used in conjunction with folding boxes and special devices for lifting. Machine moulding is a separate subject in itself from the standpoint of system. In order to get rational mass production with trained labour, the preparatory work must take into account the carrying out of the operations in proper systematic order.

Moulding Machines.*

Although moulding machines is no new subject, yet there is a good deal connected with it which is unsatisfactory. Up to the present there has not been a moulding machine introduced which could be called universal. Any so styled often turned out to be the least universal of all. It is wise, when considering installing a moulding machine, to get the advice of an expert. When travelling up and down the country it is pathetic

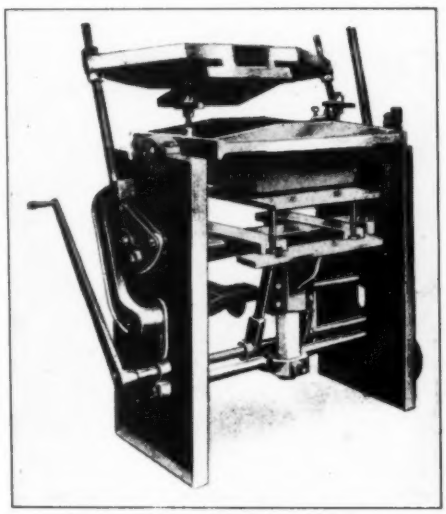


FIG. 1.—HAND-OPERATED MOULDING MACHINE WITH TURN-OVER PATTERN-PLATE.

to see machines which are never used, simply because the wrong type has been purchased for the work requiring to be done.

As a practical moulder, the author can state that this class has nothing to fear from the introduction of a moulding machine into the foundry, as it only does the donkey work, and there is always the skilled work left for the skilled man to do. Furthermore, it has to be recognised that

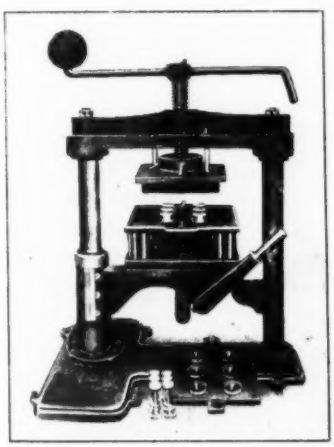


FIG. 2.—ONE TYPE OF HAND-SQUEEZING MACHINE.

this is a progressive world, and if we in this land are not prepared to progress, naturally we must fall behind.

Regarding the installation of machines without giving the matter sufficient thought. Moulding machines, more often than not, require a somewhat reverse procedure and the re-arrangement of patterns to get the most out of the machine. Not only does the preparation of the patterns play an important part, but local conditions also. Sand used in ordinary moulding is not suitable for machine moulding and foundrymen must get away from the idea that that which was good enough for the previous generation is good enough for the present.

In connection with the question of preparing pattern plates, the author has seen a complete Worthington pump, twin steam cylinders, water-suction end and cradle, made on a two-sided machine in one operation, and a better quality casting than if made by hand. When one appreciates the complicated castings of the Worthington pump, it will be recognised that the matter of giving pattern plates sufficient attention is very important. Often when the pattern calls for a dip joint, by using a core print and making a special core, although the core apparently adds to the cost of manufacture, the time saved in making the moulds more than compensates for the expense.

Perfection has not been reached, and machines cannot always compete with some of the old-fashioned methods. For instance, there is probably no moulding machine which would economically make railway chairs. At the age of sixteen the author was making 150 railway chairs for a day's work. Although that was over forty years ago, he does not think that moulding machines could show any advantage in output for this particular class of work.

Standardisation.

In this country we lack the initiative of going in for standardisation. This is a point which is being made by the Institute of British Foundrymen, which is trying to standardise compositions, tests, and moulding, as far as possible. There are hardly two systems of railways using the same

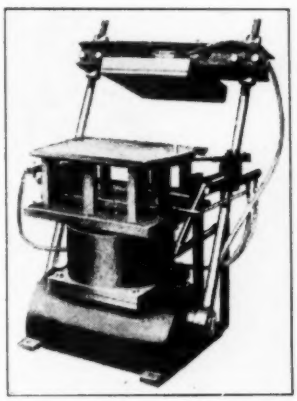


FIG. 3.—POWER MOULDING MACHINE, FREQUENTLY DESCRIBED AS A YOKE TYPE.

class of railway chair, and it is hard to understand why there are so many varieties. If we could only get standardisation up to a high level, we should get better results all round.

Moulding Machines and Apprentice Training.

Another feature which is very closely linked up with the question of moulding machines is that of apprentices. It is a recognised fact that it is almost impossible to induce a good class of boy to enter into the foundry trade, and the foremost amongst various reasons which accounts for this is that owing to the keenness of competition, foundry proprietors are compelled to get as much of the repetition work made by boy labour as possible, consequently boys do not have the same opportunity of learning the trade thoroughly. By using machines for repetition work, it would give the boys entering the foundry a better chance of learning the trade more thoroughly.

Hand-Operated Machines.

Fig. 1 represents a hand-operated moulding machine with a turn-over pattern-plate for pattern-drawing purposes, the method of operation being that the moulding box is placed on the

* A Paper read before the Wales and Monmouth Branch of the Institute of British Foundrymen, by J. McClelland, M.I.Mech.M., M.I.Brit.F. Mr. Fred Taylor, J.P., of Briton Ferry, in the chair.

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pattern plate filled with sand and the rammer-head drawn over into a vertical position, when the ramming is done by pressing the hand lever on the right. After the squeezing has been done, the rammer-head is allowed to fall back into a resting position, when the pattern-plate is turned over and the drawing plate brought into contact with the moulding box by the lever on the left-hand side of the machine. The clamps retaining the moulding box are then released, and the mould is allowed to descend clear of the pattern, when it is removed and the pattern plate reversed to its original position, and the same operation repeated.

Fig. 2 shows another type of hand-squeezing machine, one of the author's own design, the ramming being performed with the screw press arrangement as shown. After the ramming, the pattern frame is swung over beneath the rammer-head, and in the case of the pattern shown on the illustration a very ingenious pattern plate is arranged. There are six bung-ring patterns mounted on to one pattern, each ring having a very fine screw thread of a rather coarse pitch, and in order to get these patterns to draw accurately, they were all synchronised with bevel gears and operated by a single lever, which is at the back and not shown in the illustration. By turning a crank lever the patterns are screwed, and turned around in screw fashion until they entirely disappeared through the plate, thus leaving the mould free to be lifted away by hand. This machine is also arranged for the use of

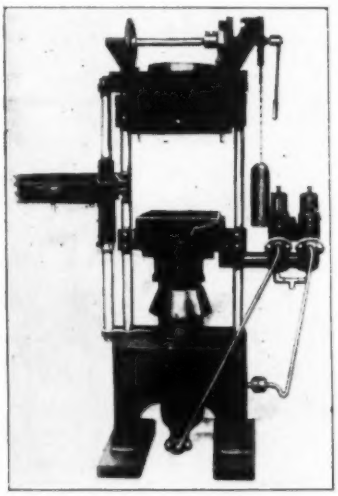

FIG. 4.—BOXLESS MACHINE. ORIGINALLY OF GERMAN INTRODUCTION.

stripping plates or straight-draw work in the ordinary way, by operating the lever as seen on the illustration. It also possesses a stool plate for stripping green-sand cores and internal lift work, and is considered to be an economical and speedy machine for the class of work coming within its range.

Power Machines.

Fig. 3 represents a power moulding machine, often described as a Yoke type. This machine is operated by pneumatic pressure, the pattern being mounted on pattern plates encircled by a moulding-box frame. Moulding boxes are placed on the machine in the ordinary way, filled with sand, and then the rammer-head is pulled over into a vertical position. The lever on the right-hand side is then pressed downwards, and the mould is raised in a vertical direction and pressed against the rammer-head. After the squeezing is completed, the lever is released, and the mould and pattern plate descend by gravity. The rammer-head is then allowed to fall back into its resting position. The surplus sand is scraped off the moulding box and the lever on the right-hand side is lifted, when the mould is withdrawn clear of the pattern, also in a vertical direction. There are some three or four makers of this type of machine, but there are only two distinctions worth mentioning. In one case the pattern drawing is performed by two cylinders on opposite corners, and in the other the patterns are drawn by a central cylinder, which in the author's opinion is the better method, because when two cylinders are employed, if one should have a tendency to lead the other, there is the danger of the mould being damaged, and when dealing with machines of this description, would always recommend central drawing cylinder.

A Boxless Machine.

Fig. 4 shows a machine which was originally a German introduction, and is known as a boxless machine—that is to say, that it takes moulds without using boxes or snap flasks. Patterns are mounted on a swing frame, shown suspended on

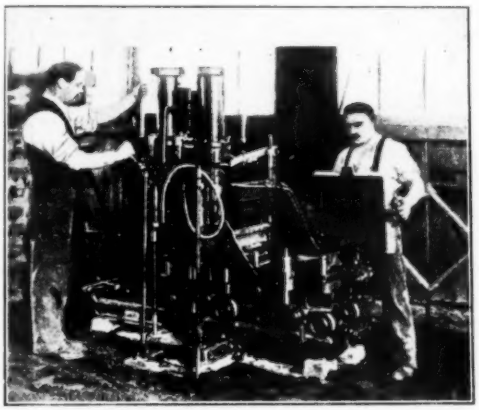

FIG. 5.—DOUBLE MACHINE, BY MEANS OF WHICH IT IS POSSIBLE TO MAKE BOTTOM MOULDS ON ONE SIDE AND TOP MOULDS ON THE OTHER SIMULTANEOUSLY.

the left-hand side of the machine, and a pattern plate also is attached. There are also a pair of frames which are intended for plaster-cast work or work with irregular joints. The patterns are mounted on these frames or on the pattern plate, as the case may be. A mould board of suitable shape and size is put into the bottom box. This box is then filled with sand, and the pattern plate swung into its normal position. The top box is then lowered on to the pattern plate by means of the lever shown on the top right-hand corner. This in turn is also filled with sand, then the lever of the inside valve is raised, and the pressure squeezes the whole by means of the rammer-head which is fixed at the top of the machine. When

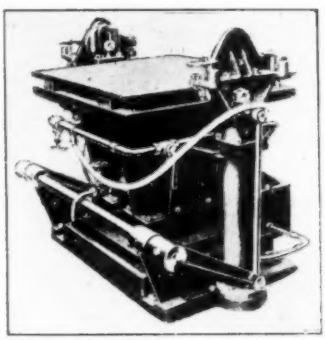

FIG. 6.—JOLT RAM TURNOVER MACHINE.

the pressure is withdrawn, both the pattern plate and the bottom box descend by gravity until they arrive at the limit of descent. By this means the patterns are drawn from the mould, leaving the pattern-plate clear. The pattern-plates are then swung to the left, as shown on the illustration, and the top box is lowered on to the bottom box again by means of a lever on the top right-hand corner, and whilst the two boxes are pinned together, thus bringing a complete mould into closed formation. Pressure is then exerted, and the mould is pushed out of the moulding box by means of a follower, when it may be carried away to the foundry floor on a bottom board, which was first put in the bottom

box. Of course, it is unnecessary to say that a machine of this type can hardly be used on anything but shallow work, and on such classes of work as globe valve wheels as many as 200 moulds have been made in one day by a couple of boys.

The machine shown in Fig. 5 was designed by the author with the intention of having a double machine, or two machines in one, so that it would be possible to make bottom moulds on one side and top moulds on the other side simultaneously without changing the pattern-plates when the top and bottom moulds do not agree exactly in shape. At the same time, this does not prevent the machine being operated from one side only, or from making different jobs on each side. The machine was designed with a view of embodying as many mechanical operations as possible to eliminate the use of labour as far as convenient, and it will be noticed that, whilst one operator is removing a mould to place on the foundry floor, another operator on the opposite side of the machine is ramming a mould. Another special feature in connection with this machine is the arrangement of the rammer-head. Prior to its introduction it was somewhat customary to use wooden blocks for rammer-heads, carved to correspond with the type of pattern which was mounted on the pattern-plate, and this often meant that after a time the pattern-plate was changed, and it was necessary to change the wooden blocks on the rammer-head also; but in this machine the rammer-head was made with a collection of small

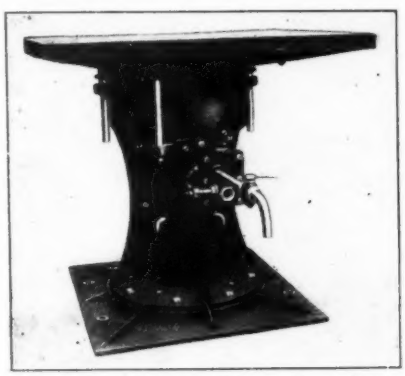

FIG. 7.—ORDINARY PLAIN JOLT RAM MACHINE.

rammers inserted. The face of each small rammer was backed up by an independent spring, thus permitting the face of the rammer-head to adjust itself to any inequality in the density of the sand as the mould was being rammed; also to the irregular shapes of patterns. Furthermore, there were thumb-screws attached to each small rammer for adjustment purposes when this was found necessary. The machine illustrated has made moulds at the rate of 50 per hour, the author having been one of four men who made 40 moulds in 45 minutes in the presence of Government Inspectors, prior to its shipment to India.

A machine of this type was supplied to a firm for making axle boxes, and, on the advice of the author, the patterns were split in half in the centre, thus making half of the casting in the bottom box and the other half in the top box. By adopting this method, it was found possible to get a greater output from the machine than would have been the case if the axle boxes were made on end, the entire pattern being in the bottom box, as is the usual custom, and this is an example of what happens in many cases when foundrymen have to adapt their pattern arrangements to facilitate machine moulding, as referred to earlier.

A similar experience is found in connection with buffer cylinders, which are usually made on end in three-part boxes, but where the design of a buffer will permit, it is much more economical to make them with a split pattern on the same lines as in the case of the axle boxes.

Jolt Ramming Machines.

Fig. 6 shows a type of machine which has proved to be very useful, and is usually described as a jolt ram turnover machine. The pattern-plate, resting on the top of the machine, is arranged to swing in trunnions and bearings mounted on two cylinders at the sides, which are synchronised with the levers and shafting as shown, which allows—when the mould has been jolted—of its being raised in a vertical direction when the pattern-plate is reversed and the mould is lowered back on to the table of the machine. The clamps holding the boxes are then released and the pattern-plate again raised in a vertical direction, taking with it, this time, the pattern only and leaving the mould behind. In conjunction with this type of machine there is also used a small trolley for pushing-under the moulding box whilst it is suspended on the lower box, and for withdrawing the mould after the pattern has been drawn.

Fig. 7 shows the ordinary plain jolt ram machine. This type of machine is found very effective more particularly for heavy work, and there again it is a relief to the moulder more than an injury, because it facilitates and helps with the hard, laborious part of the moulding trade, and this machine has been found very useful in ramming-up big jobs, where there is a quantity of sand to handle, as in turbine-engine casings, large electric motor castings, commutator ends, pulley ends, and similar work.

It is thus obvious that there are a great variety of machines to choose from, each machine having its own particular advantages. This should be some evidence that when considering the question of installing moulding machines, it is very advisable to call in an independent expert to consider the class of work it is intended to adopt to moulding machines, and then determine which is the best type of machine.

DISCUSSION.

MR. TAYLOR remarked that in South Wales they were hardly sufficiently advanced to criticise the lecture, and as there was so much jobbing work in the small foundries, it made moulding machines out of the question. Still, there was no reason why we should not enter into the big field of work which could be made by moulding machines, and compete with other parts of the country. There is always the Trade Union aspect to consider, and if he was a moulder he might eye the machines with suspicion. It is really impossible to train a good moulder on repetition work, and also a bad method of training apprentices.

MR. SCHENK asked how would a pattern of an axle box be split when it was to be cast on end.

MR. CORBY asked how a machine could be used satisfactorily in a jobbing shop. A normal day's work in his shop consisted of castings varying from a few pounds up to 15 to 20 tons. No two jobs alike, and very possibly they would never be repeated.

MR. ROGERS asked what was the minimum number of castings which would justify the cost of a machine.

PROF. BACON said that he had listened to an eminently practical man, but he wondered why railway chairs should not be suitable for machine work. He thought that many of the troubles could be eliminated in the foundry if there were more co-operation between the drawing office and the foundry. He would like to know what a "shockless jolt" was.

The Author's Reply.

In reply, MR. MCCLELLAND said that in an axle box the pattern was not split in half, but was moulded on end, the entire casting being in the bottom box. Hence the reason for not being able to get so good an output as was the case when the castings were made on their side with the pattern split through the centre.

In connection with a machine in a jobbing shop and what is the smallest number of moulds to justify the price of a machine, he could not recommend a machine for general use in jobbing work, but where there was, say, a somewhat general use of one size of moulding boxes, it was often very convenient to make small numbers of castings on a moulding machine when patterns were suitably prepared in the pattern shop, before being sent into the foundry.

In answer to Prof. Bacon, MR. MCCLELLAND said that it was not so much the fact that railway chairs were not suitable for machine work, as that there were no machines available which were

capable of improving upon the output obtained by hand ramming. Of course, railway chairs are being made by machine, but to no apparent advantage. He had submitted a design for making the chairs on their side, but instead of putting in the ordinary round holes for spiking, introduced U-shaped slots. In the ordinary way of making chairs, the pattern was made up in four pieces, having three loose pieces dovetailed into the main portion of the pattern, so that when drawing the pattern from the sand the loose pieces are left behind in the mould, and have to be picked out separately afterwards, and it is a very difficult problem to overcome these requirements by mechanical methods. In the design submitted these loose pieces would not be required, as the pattern could be split equally through the centre and top and bottom moulds made from one side of the plate. If cores could be used for the jaws, of course, the chair would be a simple matter for moulding machines, but there seems to be a general objection to cores, because of the seam they leave on the casting, in addition to the labour required for their making.

With regard to the shockless jolt, this is to convey the impression that the effect of operating the machine will have a minimum amount of jar on the foundations. Where shock-absorbing provisions are not made, there is a danger of the vibrations created on the foundry floor having a disastrous effect on any moulds which may be situated near the machine, and the shockless effect on the foundation is overcome by an annular ring containing wood blocks resting on stout springs, and self-contained in the mechanism of the machine.

With regard to the co-operation between foundry and drawing office, it is a fact that often the moulder has to overcome troubles with which he should not be bothered, and the speaker was of opinion that all drawing-office students who were going in for machine design should spend at least two years of their apprenticeship in the foundry.

A vote of thanks to Mr. McClelland was moved by Mr. Griffiths, of Swansea, and seconded by Mr. Schenk, who added that he had such faith in the uses of moulding machines that he was installing them in a new foundry which his firm were erecting.

Staffordshire Iron and Steel Institute.

Visit to Partington Steel and Iron Works.

The Staffordshire Iron and Steel Institute, on the occasion of their annual excursion on July 1, visited the works of the Partington Steel & Iron Company, Limited, at Irlam, near Manchester. The visitors numbered 45, and included the President (Mr. H. B. Jacks), Messrs. J. Payton (Past-President), J. Piper (Treasurer), and C. H. Plant (Secretary). They travelled by special saloon from Birmingham to Manchester, the rest of the journey being taken by motor char-à-banc.

The concern was established as recently as 1918, and now forms one of a group which includes Pearson & Knowles, Limited, Ryland Bros., Limited, and Armstrong, Whitworth, Limited. The area owned by the Company now comprises about 160 acres, giving ample space for further extension. The Manchester Ship Canal is adjacent, and a project about to be undertaken is the construction of a jetty, enabling materials to be brought by water carriage, and finished products shipped direct to foreign markets.

The blast-furnace plant consists of six furnaces served by 20 stoves, with 15 spacious bunkers for the stocking of ore. A sintering plant operates successfully.

The steel-making plant comprises four 60-ton and eight 40-ton furnaces, served by two mixers capable of handling 300 to 400 tons. The coke-oven plant comprises 260 ovens, giving a weekly output of 7,500 tons, with the usual by-products. When fully at work, the steel furnaces can produce weekly 7,500 tons of ingots. The soaking pits have a capacity for 136 ingots. The cogging mill is equipped with 36-in. rolls, able to turn out in a full week from 4,000 to 6,000 tons. The maximum quantity was repeatedly produced during the war. All the steel departments are operated on the triple eight-hour shift system, and at present the cogging mill and the 28-in. and 32-in. finishing mills are turning out about 4,000 tons per week. The rails are produced without re-heating direct from the ingot. The auxiliary plant includes tilting cradle, live rollers, with pendulum saws for cutting the blooms, and the usual manipulating arrangements.

Heat is derived from 33 gas producers, and the 31 Galloway Lancashire boilers are fired chiefly with coke-oven and blast-furnace gas, with coal as a standby. The boilers work at 160 lbs. pressure. Both gas and electricity are utilised for mill driving, the cogging mill being operated by a 5,000-h.p. motor, with a peak-load capacity of 15,000 h.p. In their spacious foundry the Company produce a large portion of their engine plant, and there is ample crane service. The sidings within the works total 22 miles. An up-to-date canteen furnishes 1,500 meals daily for the workpeople.

The party were entertained at luncheon, when the invitation of the managing director (Mr. F. W. Cooper) was suitably acknowledged, and thanks were tendered to Messrs. Lloyd Williams, C. Cotterill, B. Martin, W. Smart, Ll. Wyatt, J. Morgan and A. O. Jones, who aided in conducting the party round the works. MR. LEWIS (Vice-President of the Institute) complimented the Company on their modern plant, remarking that the enterprise of Lancashire in constructing its Ship Canal had been fully justified. MR. WYATT, on behalf of the managing director, acknowledged the vote.

Statistics of the Trade.

French Iron and Steel Output in May.

The number of furnaces in blast in France on June 1 was 135, as against 136 on May 1. The output of pig-iron totalled 658,397 metric tons, as against 651,323 tons in April. The May output included 34,208 tons of forge iron, 140,727 tons of foundry iron, 3,085 tons of Bessemer iron, 464,015 tons of basic iron, and 16,362 tons of special qualities.

The steel output amounted to 598,427 tons in May, compared with 567,485 tons in April. Of the May output, 584,555 tons were ingots and 13,872 tons were castings. It included 7,177 tons of acid-Bessemer steel, 381,999 tons of basic-Bessemer, 202,175 tons of open-hearth steel, 942 tons of crucible steel, and 6,127 tons of steel made in electric furnaces. Lorraine's share in the May output was 253,775 tons of pig-iron and 199,960 tons of steel.

French Iron and Steel Imports and Exports in May.

French iron and steel imports in May included the following items in metric tons :—Pig-iron, 3,845; ferro-alloys, 2,353; steel ingots, —; blooms, billets and bars, 18,782; rails, 13,455; plates and sheets, 6,886; special steels, 802; hoops, 4,301; wheels, axles and tyres, 200; wire rods, 1,693; wire, 953; wire nails, 68; tubes, 2,914; tinplates, 3,991; springs, 6; castings, 435; structural iron and steel, 1,988; scrap, 5,019; total, 55,581 tons.

French imports of iron ore during May totalled 93,898 tons, including 34,971 tons from Belgium and Luxemburg; 32,945 tons from Spain; 2,243 tons from Algeria, and 14,850 tons from Tunis.

French exports of iron and steel in May included, in metric tons :—Pig-iron, 47,130; ferro-alloys, 1,365; steel ingots, 828; blooms, billets and bars, etc., 120,152 tons; rails, 22,688; plates and sheets, 5,414; special steels, 141; hoops, 2,034; wheels, axles and tyres, 784; wire rods, 5,097; wire, 2,859; wire nails, 1,039; tubes, 1,718; tinplates, 607; springs, 167; castings, 9,181; structural, 3,446; scrap, 26,010; total, 250,660 tons.

Saar Pig-iron and Steel Output, First Quarter 1924.

We give below, in metric tons, the production of pig-iron and steel ingots in the Saar during the first quarter of this year, with figures for the corresponding period of 1923 in parentheses :—The total production of pig-iron (basic) was 336,703 tons (183,256 tons), and of steel ingots, 387,134 tons (175,932 tons), of which 284,188 tons (139,128 tons) were basic open-hearth, 100,666 tons (35,243 tons) acid open-hearth, and 2,280 tons (1,561 tons) electric. The output of pig-iron and of acid open-hearth ingots exceeded the 1913 figures (101,817 tons and 28,300 tons respectively).

Stroh Steel Wagon Wheels.—Among the advantages claimed for the construction of wagon and other wheels, gears, etc., by this process, are that the hub and body may be of any desired metal, cast-steel of low or high carbon content, while the tread and inside of the flange or flanges which are subject to wear and shock are of the hardest alloy known in metallurgy. The flanges cannot fracture and the tread will not peel off. This wearing surface, says the Stroh Steel-Hardening Process Company, of Pittsburg, Pa., U.S.A., the originators of this method, is an integral part of the casting, of known and controlled depth and character, wearproof, and having a high elastic limit.

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.

THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

JAMES EVANS & CO., BRITANNIA WORKS (MANCHESTER), LIMITED.

BLACKFRIARS, MANCHESTER.

Trade Talk.

JAMES W. SMALLMAN, LIMITED, have removed to 10, Priory Row, Coventry.

SOC. ANONYME SILICA DE PEISSANT OF MONS, BELGIUM, have removed their address in Leeds to 3, Park Place.

ALLEN WEST & COMPANY, LIMITED, Lewes Road, Brighton, have removed their Manchester office to 3, The Parsonage, Manchester.

DAVY BROTHERS, LIMITED, propose to make a new issue of debentures in the autumn. The existing debentures of £30,000 mature in October.

DISMANTLING OPERATIONS by the Lewis Company, Workington, at the Wyndham Mines Helder Pit dispels the hope that the mine might resume working.

FULLER'S UNITED ELECTRIC WORKS, LIMITED, Woodland Works, Chadwell Heath, Essex, have removed their Midland office to 5-9, Severn Street, Birmingham.

REPAIRS HAVING BEEN completed at their Ormesby Ironworks, Middlesbrough, Cochrane & Company, Limited, have decided to blow in another blast-furnace.

BRANDEIS GOLDSCHMIDT & COMPANY, metal merchants, of 18, Fenchurch Street, London, E.C.3, have taken Mr. W. v. d. Porten and Mr. A. E. Furst into partnership.

THE E. W. HARVEY GAS FURNACE COMPANY, LIMITED, of 70, Victoria Street, London, S.W.1, have changed the title of their company to Harvey-Siemens Furnaces, Limited.

A FIRE BROKE OUT on the premises of Hunter & Jack, electrical and heating engineers, 38, Elliot Street, Cranstonhill, Glasgow, on July 3, considerable damage being done.

D. M. HENDERSON & COMPANY, LIMITED, have removed from 141, Moorgate, E.C.2, to 66A, Farringdon Street, London E.C.4. The firm manufacture "Isolit," an insulating cement which they are supplying to collieries.

THE IMPORTS of foreign iron ore at the Senhouse dock at Maryport for the second quarter of the year amounted to 36,930 tons, against 22,450 tons for the previous quarter, and 30,200 tons at the corresponding period of last year.

THE DUTCH GOVERNMENT has passed a vote of credit for two million florins (£177,083) on account of the War Department estimates to enable it to carry out a contract with Sir W. G. Armstrong, Whitworth & Company, Limited, for the delivery of war material.

THE AVERAGE net selling price of No. 3 Cleveland pig-iron for the second quarter of the year was 89s. 9.13d. per ton, as compared with 95s. 8.94d. for the previous three months. This carries a reduction of 6¼ per cent. in North-East Coast blast-furnacemen's wages.

THE NORTH-WESTERN ELECTRICAL COMPANY, LIMITED, will in future trade under the style of N.W.E. Limited, at 54/55, Strand, Barrow-in-Furness. The company have been appointed agents for Fuller's Cables in South Cumberland, Westmorland, and a portion of Lancashire.

VICKERS, LIMITED, have secured an order for heavy gun-mountings for two of the new British cruisers, one of which is to be built at Barrow. The firm have also received a contract for supplying the smaller gun-mountings for the two capital ships now building at Birkenhead and on the Tyne.

STOTHERT & PITT, LIMITED, of Bath, inform us that the resignation of their chief engineer, Mr. C. M. Toplis, will not affect the manufacture of their horizontal luffing cranes ("Toplis" patents), the sole interests and any subsequent improvements in the patents being assigned exclusively to them.

AN INDICATION OF the depression which has hitherto prevailed in the West Coast hematite pig-iron trade is furnished by the decline as revealed by the ascertainment for May and June in the price of iron by 1s. 10d. to £4 19s. 11d. per ton. Cumberland and North Lancashire blast-furnacemen's wages accordingly suffer a reduction of 2¼ per cent.

Gazette.

MESSRS. T. PRICE, W. PRICE AND J. PRICE, scrap iron dealers, 77, Vittoria Street, Smethwick, trading under the style of Maria Price & Sons, have dissolved partnership.

MESSRS. S. BRUCE and A. J. GOLBY, boiler engineers, Wadsley Bridge, Owlerton, Sheffield, trading under the style of Bruce, Golby & Company, have dissolved partnership.

THE EXCELSIOR METAL COMPANY, LIMITED, are being wound up voluntarily. Messrs. Desmond Page & Adams, 13, Victoria Street, S.W.1, have been appointed liquidators.

THE SHAREHOLDERS of the Reliance Fuel Company, Limited, have decided to wind up the company voluntarily. Mr. W. J. Yeoman, 17, Throgmorton Avenue, E.C.2, has been appointed liquidator.

Company News.

Steel Developments, Limited.—Interim dividend, 5 per cent. per annum, free of tax.

Cable and Metals, Limited, 31, Queen Victoria Street, London, E.C.—Capital £1,000.

Greenwood & Batley, Limited.—Final dividend, 2½ per cent., making 5 per cent. for year.

Herbert Morris, Limited.—Dividend for half-year on ordinary shares, 7½ per cent. per annum.

Hobbs, Hart & Company, Limited.—Dividend 12 per cent. per annum (1s. 9 3-5d. per share).

Electrical Distribution of Yorkshire, Limited.—Interim dividend, 3½ per cent. on ordinary shares.

Telegraph Construction and Maintenance Company, Limited.—Interim dividend, 6s. per share, free of tax.

Dickson & Mann, Limited.—Loss for year £4,321; depreciation, £400; debit brought forward increased to £9,381.

Yorkshire Electric Power Company, Limited.—Interim dividend, 3 per cent. on ordinary and preference shares.

Marathon Engineering Company, Limited, Marathon Works, Lever Street, Wolverhampton.—Capital £3,000 in £1 shares.

Paisley Brass Works Company, Limited, 12, Hamilton Street, Paisley.—Capital £15,000. Secretary: D. Robertson, junr.

William Foster & Company, Limited. — Loss, £8,252; transferred from reserve, £15,000; credit balance £3,086 carried forward.

R. Roberts, Limited, 53, Newton Street, Birmingham.—Capital £1,000 in £1 shares. Electrical engineers. Directors: R. Roberts and G. Bayliss.

Marsham Engineering Company, Limited, 33, New Kent Road, London, S.E.—Capital £150 in £1 shares. Directors: J. Blower, Mrs. L. Sangster.

North Glamorgan Wagon Company, Limited.—Profit, £2,835; brought forward, £5,814; dividend, 10 per cent., making 12½ per cent. for year; carry forward, £6,999.

J. Stone & Company, Limited.—Net profits, £165,340; brought forward, £147,591; dividend, 10 per cent. on ordinary shares; reserve, £75,000; carry forward, £138,891.

Drum Repairs, Limited, 93A, Worsley Road, Patricroft, Lancashire.—Capital £1,000 in £1 shares. Manufacturers and repairers of steel drums, etc. Directors: H. Pinnington and A. G. Hatch.

Edgar M. Clarke, Limited, 448, Strand, London, W.C.2.—Capital £10,000 in £1 shares (6,000 5 per cent. cumulative preference, 2,000 7 per cent. participating preference, and 2,000 ordinary). Iron merchants.

Joseph Thompson & Company (Liverpool), Limited, 290, Vauxhall Road, Liverpool.—Capital £1,500 in £1 shares (1,000 7 per cent. cumulative preference). Machinery, chain and anchor merchants. Director: J. Thompson.

Mond Nickel Company, Limited.—Net profit, £262,634; brought forward, £65,268; available, £327,903; final dividend on ordinary shares, 1s 6d., less tax, making 2s. 6d. per share, less tax, for year; carry forward, £40,403.

A. S. Cartwright, Limited, 75, Ford Street, Hockley, Birmingham.—Capital £5,000 in £1 shares, to acquire the business of stampers and piercers lately carried on by A. S. Cartwright, Limited (in liquidation), at West Heath Works, Northfield.

British Schurmann Cupola and Foundry Equipment Company, Limited, St. Stephen's House, Victoria Embankment, London, S.W.—Capital £1,000 in £1 shares. Directors: J. A. Smeeton, E. S. H. Corbett, Dr. Siegfried G. Werner and Franz Hilger.

Rees Roturbo Manufacturing Company, Limited.—Depreciation, £3,000; credit balance, including amount brought forward, after transferring £5,000 from general reserve and £7,000 from taxation reserve, £582; added to capital expenditure for tools, etc., £1,572.

Richardson, Duck & Company, Limited.—Brought forward, £37,228; loss after providing for Government taxation, £10,156; preference dividend to January 31, 1923, £2,479; debenture interest to December 31, 1923, £16,250; debenture sinking fund to December 31, 1923, £1,167; carry forward, £7,175.

Obituary.

MR. GEORGE JONES, manager of the Basic Slag Company, Limited, Newport, Mon., died suddenly on July 3.

Mr. W. A. Pearn, one of the directors of Frank Pearn & Company, Limited, West Gorton, Manchester, who had been associated with the company for 50 years, died recently.

MR. RUDOLPH JAEGER, head of the firm of Jaeger Brothers, iron and steel merchants, of London and Middlesbrough, died at his residence at Kilburn, London, N.W., recently. Some 20 years ago Mr. Jaeger was a prominent figure in Middlesbrough commercial circles.

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IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—A slightly more active business has developed in the Cleveland iron market, consequent upon a marked improvement in inquiry on both home and shipment account, with a fair volume of buying coming from Scottish consumers. In the North of England, too, the foundries are taking more interest, while in spite of the exchange situation, there are indications of a renewal of inquiry from the Continent. In the home trade the fall in values would appear at last to have had the effect of bringing consumers into the market. At this week's market there was a firmer tone prevailing, and makers were not quoting No. 3 G.M.B. at less than 87s. 6d. per ton, f.o.b., though this figure could perhaps be shaded somewhat for home trade. No. 1 was 92s., No. 4 foundry 86s., and No. 4 forge 85s. per ton.

The rather better inquiry for foundry pig-iron does not appear to be reflected in the case of hematite, and values of the latter again show a weaker tendency. Makers are quoting East Coast mixed numbers at 95s., which is 1s. below the previous nominal quotation, but in some cases even this could be shaded. On the North-West Coast there is also a weaker tendency in hematite prices, Bessemer mixed numbers being 2s. 6d. per ton below the quoted figure of 107s. 6d. per ton delivered at Glasgow, 112s. 6d. per ton delivered at Sheffield, and 117s. 6d. per ton delivered at Birmingham.

LANCASHIRE.—Conditions in the local foundry iron position remain unsatisfactory, and with demand on the limited side prices show a lower tendency. Midland pig-irons are reported to have been offered at Manchester at 97s. 6d per ton, or fully 2s. 6d. per ton less than was customary before the coke prices were fixed; but, so far, Derbyshire No. 3 has not been quoted here below 98s. 6d. It is, however, probable that Derbyshire iron could be bought here at 98s., and possibly at 97s. 6d.; but foundrymen in Manchester are by no means satisfied that this is a bottom price.

THE MIDLANDS.—Movements in the South Staffs markets for foundry pig are still on a restricted scale, with prices again easier. Quotations now rule as follow:—Derbyshire No. 3 foundry, 90s. to 91s.; Staffordshire No. 3 foundry, 90s. to 91s.; Northants No. 3 foundry, 87s. to 87s. 6d.

SCOTLAND.—No improvement in demand can be reported in the market for foundry iron, nor is it anticipated that a change for the better will materialise until the year is further advanced. The tendency of prices is again lower, the quotation for No. 3 quality ruling at 95s. per ton f.o.t. furnaces. The trouble impending with the light castings industry employés will no doubt tend to keep business back, but it is to be hoped that there will be no stoppage of work. Continental foundry iron can be bought at 90s. at Falkirk, but no business is reported.

Finished Iron.

Business in most descriptions of manufactured material continues inactive, orders being of a miscellaneous nature and lack tonnage of any account. The specifications for marked bars are coming through somewhat better; the chief dearth of business applying to the manufacturers of crown and nut and bolt iron, who have had a very lean time for some months, and at present see no early prospect of better times. In spite of this inactivity there are no signs at the moment of their accepting less than £12 15s. for crown bars, but it is not considered that this price will hold good much longer. Marked bars remain at £15 f.o.t. makers' works, and this figure is likely to remain constant for a period. The suppliers of nut and bolt iron ask for £11 15s., but orders are being placed at 2s. 6d. to 5s. below this figure.

Steel.

Only a limited volume of inquiries is just now in circulation for steel, and makers on the whole are by no means fully employed. The buying of billets of all classes is on a very small scale. Steel manufacturers report that a large proportion of the open-hearth plant is idle, while rolling mills and forges are unable to find sufficient work to keep them going. Business in the market for ferro-alloys is on a correspondingly quiet scale, with few changes in prices to note. There has not been a great deal doing the last week or so in tinplates. Buyers have evidently filled their requirements for the time being, and are not disposed to purchase ahead to any extent. Makers, on the other hand, being comfortably booked up for some weeks, are not showing any anxiety to push sales unless at an advance on the official minimum of 22s. 7½d. net cash, f.o.b. Bristol Channel ports.

Scrap.

Corresponding conditions to those above outlined are found in the various markets for scrap material, with a gradual weakening of prices. In Lancashire the foundries are poorly off for work, and demand is consequently slack, particularly for cast-iron scrap. With pig-iron from 2s. 6d. to 3s. cheaper, there is a claim for cheaper foundry scrap, and although the stronger dealers here are still trying to keep the price of good, broken machinery cast iron up to 90s., it is clear that less money is being accepted. In the Scottish markets also machinery cast-iron scrap is easy at 95s. per ton, while for ordinary quality to the same specification, i.e., in pieces not exceeding 1 cwt., and suitable for foundries, 3s. 6d. per ton to 5s. per ton less is quoted. Old cast-iron railway chairs have been reported sold at 93s. 6d. and 95s. per ton. Light cast-iron scrap can be bought at 75s. per ton, and if mixed with firebars, 2s. 6d. per ton less. The above prices are all per ton, delivered f.o.t. consumers' works.

Metals.

Copper.—The position in the standard market at the moment is mainly dominated by the speculative element, price fluctuations being confined within narrow limits and the tendency mostly towards increasing steadiness, in many respects the Continental situation appears to be mending slowly. Imports have been growing rapidly, and it is obvious that if the Dawes report is accepted by the Germans, there will be a rapid and substantial increase in the European consumption of copper. Current quotations:—*Cash*: Thursday, £61; Friday, £60 15s.; Monday, £60 17s. 6d.; Tuesday, £60 17s. 6d.; Wednesday, £61. *Three Months*: Thursday, £62; Friday, £61 15s.; Monday, £61 17s. 6d.; Tuesday, £61 17s. 6d.; Wednesday, £61 17s. 6d.

Tin.—Movements in the market for standard tin have indicated a somewhat weaker tendency in values, due, it is inferred, to the continued abstention of American and Continental buyers, and to a slower consumption in home industries. Only small quantities are being sold in the East, but should values show signs of a substantial increase freer selling from that quarter might be expected. The Government of the Federated Malay States sold no tin during the month of June. The total amount of tin sold up to date under the Bandoeng agreement is 6,175 tons. Current quotations:—*Cash*: Thursday, £220 10s.; Friday, £222 2s. 6d.; Monday, £226 10s.; Tuesday, £226 5s.; Wednesday, £231 10s. *Three Months*: Thursday, £222 10s.; Friday, £224 2s. 6d.; Monday, £228 10s.; Tuesday, £227 15s.; Wednesday, £232 15s.

Spelter.—Values of this metal have been steadily maintained during the past week, and a good average amount of buying is reported on home consumers' account. Although Belgian smelters are increasing their output, they are by no means anxious to dispose of their production. Buyers appear to be confining operations to near dates, and the outlook is rather uncertain. Current quotations:—*Ordinary*: Thursday, £31 17s. 6d.; Friday, £32 1s. 3d.; Monday, £32 3s. 9d.; Tuesday, £32 2s. 6d.; Wednesday, £32 1s. 3d.

Lead.—The market for soft foreign pig continues fairly steady, and both near and prompt supplies are firmly held. The extra supplies from Mexico have not yet arrived, but the mere fact that these reports were in circulation caused some hesitation. On the whole, however, heavier calls are now being made. The backwardation in forward delivery is inclined to go down; but it is still very considerable, and the opinion in the manufacturing areas here is that the price is too high to permit of a large expansion in the demand. Current quotations:—*Soft foreign (prompt)*: Thursday, £33 7s. 6d.; Friday, £32 15s.; Monday, £32 17s. 6d.; Tuesday, £32 15s.; Wednesday, £32 17s. 6d.

MR. G. F. O'RIORDAN, head of the Engineering Department at the Hull Technical College, has been appointed to the principalship of the Leicester Technical School. Mr. Arnold W. Gibson has been appointed to succeed Mr. O'Riordan at Hull.

MR. W. J. REEVES, manager, and Mr. T. Crowther-Green, works manager, at the works of Rubery, Owen & Company, engineers, Darlaston, have been the recipients of presentations from the officials and employés on their severing their connections with the firm after 20 and 25 years' service respectively.